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NASA HISTORICAL DATA BOOK
Volume I

NASA Resources 1958-1968

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with
Robert L. Rosholt

The NASA Historical Series

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FOREWORD

A decade in the life of an organization as dynamic and multifaceted as the National Aeronautics and Space Administration offers a large enough canvas to discern clearly the patterns and trends of the organization's life. For NASA, the decade which closed on October 1, 1968, was its first. That decade has been–and will continue to be–studied by many people and from many perspectives.

It is with the hope of stimulating such studies that NASA is offering the *NASA Historical Data Book, 1958-1968,* of which this volume, *NASA Resources,* is the first. The intent of the series is to provide a comprehensive, factual data base on the tangible aspects of NASA and its programs. The first volume covers organization and management; the second will cover the individual space and aeronautics programs.

This volume deals primarily with the resources which the Nation made available to NASA in that decade and traces the allocation of those resources. The perceptive eye will find much of NASA history and management philosophy, as well as many decisions, reflected in these columns of numbers. In the 1958-1961 period, there is evidence of the piecing together of a new agency to continue research in aeronautics while undertaking the leadership of the Nation's civilian space program. This involved the assimilating of organization, facilities, program, and people from a number of Government agencies and creating out of them a new organization and program. From 1961 to 1966, one can trace the national commitment to an expanded space program, expressed in the doubling and redoubling of resources and the growing momentum. In the 1967-1968 period, the lower costs mark the shift in the Apollo program from development and procurement into its operational phase.

This was the decade in which the United States made its commitment to space exploration and demonstrated its capacity to achieve large and difficult goals in a sustained, orderly, and open program. From a historical point of view, in the short period of a decade, the exploration of the space frontier was generating a new Copernican Revolution in our perception of ourselves and our earth. The achievements in space sciences were sparking a rethinking of the educational curriculum. Communications and meteorological satellites progressed from experiment to global systems bringing important daily benefits to people on earth. Growing perception of this national capacity to mobilize, coupled with that other legacy from Apollo–the picture of our beautiful, fragile planet as "spaceship earth"–may in the long view of history rank as even more significant than its tremendous achievements in technology and science.

George M. Low
Deputy Administrator

April 20, 1974

PREFACE

The series of which this is the first volume is meant to provide a comprehensive statistical summary of the first decade of the National Aeronautics and Space Administration, from its post-Sputnik creation until the *Apollo 8* astronauts became the first men to circle the moon. Volume I, *NASA Resources*, measures dollars, people, and things. It is designed as a reference source for a variety of purposes. In many ways it offers time-oriented data comparable to a chronology, but from a quantitative perspective. The statistical summary of NASA's first 10 years documents, in a nuts-and-bolts fashion, the immense growth and eventual leveling off of the agency's program. It covers NASA's budget and financial history, its scattered installations, its manpower resources, and a statistical summary of its contractual history. A companion volume, NASA Programs, is under way. It will provide similar statistical data for each NASA program.

Chapter I of the present volume briefly sketches the first 10 years, touching upon organization and management and fiscal, personnel, and procurement matters. Each subsequent chapter examines a significant segment of NASA's total physical resources. Chapter II, "NASA Facilities," describes the physical history. It documents NASA's inheritance in physical plant from the National Advisory Committee for Aeronautics (NACA) and locates in time and place the $2.5 billion obligated for construction of new facilities. Particulars such as capitalized equipment value, total acreage, and value and number of buildings owned are included. The geographical and physical dimensions of NASA are thus given statistical meaning.

Chapter III is focused on manpower, mainly in-house civil servants and their locations. Most of the chapter consists of basic tables showing changes in personnel over time.

Chapter IV documents dollars. Its objective is to supply information on budget, appropriations, obligations, expenditures, and all other money-related matters. In other words, it helps portray how NASA managed its dollar resources.

Chapter V depicts statistically the scope and key role that academic and industrial contractors have played in the history of NASA. As with previous chapters, the data are presented in tabular form, with total agency variables broken down by fiscal years. Some of the more important variables also include an installation breakdown. Information such as the number of procurement actions, value of contract awards, and geographical distribution of contracts is presented. The chapter concludes with a chronological recapitulation of the major NASA contractors over the past 10 years.

The final and longest chapter describes NASA's existing field installations. Information on origin, growth, facilities, activities, and leadership is presented. Data are then tabulated by installation.

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This work makes no interpretive attempts whatsoever, but rather concentrates on its specific, concrete, and necessarily limited goal. It also is by no means a creative effort–creative in the sense of generating new data. All the information presented predates this volume and was initially in a fragmented, decentralized form. It was gathered from the individual Centers, the Headquarters program offices, and various NASA publications and selected, reduced, and repackaged in a format hoped to be intelligible, informative, and easily accessible. This is basically a reference *data* book and therefore predominantly tabular in form. Narrative is included whenever necessary to explain the data and offer additional information.

Such a work necessarily has limitations. For example, the reader will note many blanks in the data for the early years 1958-1961. The dynamism of these early years, reflected in its nearly geometric growth pattern, cannot be overemphasized. Physical growth was only one dimension. The mission of the new agency expanded by an order of magnitude over that of its predecessor NACA; furthermore there was a radical change in direction both in the emphasis on space over aeronautics and in the way in which the agency did its business. The switch from in-house research to massive contracting with industry and universities caused a serious overload in administration. The day-to-day exigencies of this very fluid situation tended to restrict record-keeping to the essentials. When the initially composite nature of the agency–an amalgam of many then-disparate groups, organizations, and on-going space projects–is added, the new agency's situation becomes even more understandable. All of these factors made for a relative lack of data during NASA's turbulent formative period. In some cases data were available but differing methods used in handling information resulted in dissimilarities in data collection and packaging. What may appear as gaps, approximations, or even discrepancies in the early data, is usually the result of the dynamism of this formative period.

With the necessary haste of its hectic years behind it, NASA settled down and matured, and its information system became regularized and systematized. But here another problem developed. Because of its own thoroughness, the agency soon felt the weight of burgeoning amounts of data. At times, too much information was available, and the researcher faced the opposite difficulty. If NASA's early years were "information-scarce," its later years were "information-abundant."

The volume was sponsored by the NASA Historical Office under exchange-of-funds agreement No. W-12322 with the Science and Technology Division of the Library of Congress. While all three authors shared responsibility for nearly every section of the book, Mrs. Jane Van Nimmen, formerly of the Library of Congress, prepared Chapters Two, Five, and Six; and Chapters Three and Four were prepared by Dr. Robert L. Rosholt of Bloomsburg State College, also author of *An Administrative History of NASA, 1958-1963* (SP-4101). Leonard C. Bruno of the Library of Congress prepared Chapter One and also revised the entire volume. Mrs. Gay Arnelle, formerly of the Library of Congress, served as editorial assistant and was succeeded by Mrs. May Faye Johnson of the Library. Mrs. Arnelle also prepared Appendix A, Selected Aerospace Awards.

The authors are particularly grateful to Dr. Frank W. Anderson, Jr., Deputy Director, NASA Historical Office, for his sympathetic supervision of the entire project, and to Carrie E. Karegeannes, for her diligence in preparing the manuscript for press. Origins of NASA Names, an unpublished manuscript by Helen T. Anderson with Susan Whiteley, both formerly of the NASA Historical Office, was used in preparing the final chapter. Among the many NASA people who have contributed to the book, some have given particularly generous support: Hazel W. Bogert, Howard N. Braithwaite, Frederick L. Dunlap, C. Guy Ferguson, James M. Grimwood, Harry W. Hammann, Charles M. Hochberg, Robert E. Hunt, Charles W. Kelly, William R. Leaman, Edward T. Mecutchen, Dominick C. Polizzi, Lee D. Saegesser, and George R. West. They of course bear no responsibility for the completeness or accuracy of this work.

Leonard C. Bruno
March 1974

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CHAPTER ONE

INTRODUCTION

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CHAPTER ONE

INTRODUCTION

The National Aeronautics and Space Administration (NASA), created as a national decision by the Congress and the President, began operations on October 1, 1958. In effect, its coming-in-to-being was a direct response to the U.S.S.R.'s first achievements in space.

On August 27, 1957, the Soviet news agency Tass announced in Moscow that Russia had successfully tested an intercontinental-range ballistic missile.[1] The United States had earlier done the same, and the decision by these two large powers to add intercontinental ballistic missiles to their military arsenals had quickly advanced the art of rocket propulsion and related technology. The large thrust of these liquid-fueled rockets had made space flight a practical possibility for the first time.

Six weeks after its missile test, the U.S.S.R. was the first to orbit an artificial earth satellite, *Sputnik I* on October 4, 1957.[2] Reaction in the U.S. immediately following Russia's success was a concern blending both chagrin and alarm.[3] The chagrin came from the knowledge that the U.S. might have been first to orbit a satellite if it had used military missiles, but instead had allowed the Soviets to capture this world scientific triumph. The alarm was for the challenge to national security; many feared that we had fallen far behind, especially in nuclear-tipped intercontinental ballistic missiles. The much heavier *Sputnik II*, in November, carrying the dog Laika, compounded the technological surprise and worldwide propaganda harvest for the Kremlin.[4]

Significant amidst the initial flurry of U.S. activity immediately following the Soviet Sputniks were sweeping congressional hearings, "Inquiry into Satellite and Missile Programs," conducted by the Preparedness Subcommittee of the Senate Armed Services Committee, chaired by Senator Lyndon B. Johnson. This subcommittee held 20 meetings between November 25, 1957,

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[1] Eugene M. Emme, *Aeronautics and Astronautics: An American Chronology of Science and Technology in the Exploration of Space, 1915-1960* (Washington, D.C.: NASA, 1961), p. 87.

[2] *Ibid.*, p. 91.

[3] Jay Holmes, *America on the Moon: The Enterprise of the Sixties* (Philadelphia: Lippincott, 1962).

[4] Emme, *Aeronautics and Astronautics, 1915-1960*, p. 91.

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and January 23, 1958, and unanimously adopted 17 recommendations.[5] Their report urged increased space and missile spending and emphasized the importance of space exploration as a national objective. Before the hearings were over the U.S. had successfully orbited *Explorer I*,[6] but still had no centralized, national space program or an agency to run it. It was not generally realized that the scientific experiment of James A. Van Allen carried by *Explorer I* was to make the greatest scientific discovery of the International Geophysical Year.

Thus, by the beginning of the 1958 congressional session, numerous bills were introduced, each reflecting a different perspective on U.S. space policy. President Eisenhower submitted a bill recommending creation of a National Aeronautics and Space Agency on April 14, 1958, and both houses of Congress formed ad hoc blue-ribbon committees to deal with the issue of legislating the basis for a space program and determining its general policy guidelines.[7] These hearings got underway on April 15. On July 29, the National Aeronautics and Space Act of 1958 was signed by President Eisenhower.[8]

The new agency was to be headed by an Administrator and a Deputy Administrator, both appointed by the President with the advice and consent of the Senate.[9] President Eisenhower nominated Thomas Keith Glennan to be the first Administrator of NASA. Hugh L. Dryden, Director of the National Advisory Committee for Aeronautics (NACA), was selected as Deputy Administrator. Glennan was president of Case Institute of Technology. The nominations were promptly confirmed by the Senate and the two assumed office on August 19, 1958. On September 25, Glennan announced that NASA would begin functioning on October 1, 1958.[10]

The First Decade of NASA

The early history of NASA was largely one of consolidating a national program out of projects, facilities, and personnel of Government agencies, the scientific community, and the aerospace industries. From its first day, NASA had to organize itself, recast the former NACA and its 8000 employees as the organizational core of the new civilian effort, follow through with the scientific earth satellite and lunar probes inherited from the Department of Defense's Advanced Research Projects Agency (ARPA), and integrate the

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[5] U.S. Congress, Senate, Preparedness Investigating Subcommittee on Armed Services, *Inquiry into Satellite and Missile Programs, Hearings*, Pts. 1 and 2, 85th Cong., 1st and 2d sess., Nov. 25-27, Dec. 13, 14, 16, 17, 1957; Jan. 6, 8-10, 13-17, 20-23, 1958 (Washington, D.C.: GPO, 1958).

[6] Emme, *Aeronautics and Astronautics, 1915-1960*, p. 95.

[7] *Ibid.*, p. 97.

[8] *Ibid.*, p. 100.

[9] Robert L. Rosholt, *An Administrative History of NASA, 1958-1963* (Washington, D.C.: NASA SP-4101, 1966), p. 309.

[10] Emme, *Aeronautics and Astronautics, 1915-1960*, p. 102.

International Geophysical Year (IGY) satellite program (Vanguard).[11] The Army-owned Jet Propulsion Laboratory (JPL), staffed and operated by the California Institute of Technology (Cal Tech), was transferred to NASA in December 1958. And although NASA requested transfer of about half of the Army Ballistic Missile Agency's (ABMA) Development Operations Division in late 1958, it was not until a year later that the space agency received both the ABMA's Development Operations Division (the von Braun team) and its Saturn launch vehicle project as well.

Thus in 1958 NASA was indeed a modest-sized pieced-together conglomerate, created as a national response to the Soviet space challenge, with an excellent base in facilities and experienced people, but with many resource problems if it was to carry out its ambitious mission laid out in the Space Act. As it gradually assumed direction, programs, and momentum, it was soon to be transformed into a powerful and efficient goal-oriented organization. Never had an agency been created from so many disparate programs or exhibited such geometric growth in its early years. Most significant in the pace of NASA's transformation was President John F. Kennedy's call of May 25, 1961, for a national decision to land an American on the moon in the 1960s.[12] Before this pivotal point in NASA's history, the young agency had

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[11] For an excellent history of this project, see Constance McL. Green and Milton Lomask, *Project Vanguard–A History* (Washington, D.C.: NASA SP-4202, 1970).

[12] For documentation and commentary on the Apollo decision, see John M. Logsdon, *The Decision To Go to the Moon: Project Apollo and the National Interest* (Cambridge, Mass.: Massachusetts Institute of Technology, 1970); Vernon Van Dyke, *Pride and Power: The Rationale of the Space Program* (Urbana, Ill.: University of Illinois, 1964); Eugene M. Emme, "Historical Perspectives on Apollo," *Journal of Spacecraft and Rockets*, April 1968, pp. 369-382; Memorandum, Hugh Dryden to NASA Historical Office on Eisenhower-Kennedy Transition, Sept. 27, 1965 (copy in NASA Historical Archives); Jay Holmes, *America on the Moon: The Enterprise of the Sixties* (Philadelphia: J. B. Lippincott Co., 1962); *Historical Sketch of NASA* (Washington, D.C.: NASA EP-29, 1965).

For a top-level view of NASA organization and management, see T. Keith Glennan, "The Challenge of the Space Age," speech before Fort Worth, Texas, Chamber of Commerce Annual Banquet, Dec. 8, 1958; T. Keith Glennan, "A National Space Program for Space Research," speech before Institute of the Aeronautical Sciences, New York, Jan. 27, 1959; Transition Memorandum Prepared by T. Keith Glennan, January 1961 (copy in NASA Historical Archives); James E. Webb, *Space Age Management* (New York: McGraw-Hill, 1969), McKinsey Foundation Lecture Series sponsored by the Graduate School of Business, Columbia Univ.; James E. Webb, "NASA as an Adaptive Organization," John Diebold Lecture on Technological Change and Management, Harvard Univ. Graduate School of Business Administration, Boston, Sept. 30, 1968; James E. Webb commentary in *Harmonizing Technological Developments and Social Policy in America*, James C. Charlesworth, ed. (Philadelphia: American Academy of Political and Social Science, 1970), pp. 113-118; James E. Webb, "Foreword," in Rosholt, *Administrative History of NASA*; Hugh L. Dryden, "NASA Mission and Long-Range Plan," *Proceedings, NASA-Industry Program Plans Conference* (Washington: July 28-29, 1960), pp. 6-9; Hugh L. Dryden, "The Overall NASA Space Program," *Proceedings, Fourth International Symposium on Space Technology and Science*, Aug. 27-31, 1962, Tamiya Nomura, ed. (Tokyo, Japan, and Rutland, Vt.: Japan Publications Trading Co., 1963), pp. 1-5; Hugh L. Dryden, "The U.S. Space Program–What Is It? Where Is It Going? Why Is It Important?" *Presentation of the Gold Medal of the International Benjamin Franklin Society to Dr. Hugh Latimer Dryden. . January 19, 1963* (New York: Franklin Society, 1963); Interview with Hugh Dryden conducted by formulated its plan for the decade ahead, was operating its transferred programs, had laid down initial programs, and was conducting the manned Mercury program. But it was quite unsure of its long-range support, particularly beyond Mercury. President Kennedy's response to the dramatic Soviet space challenge (Cosmonaut Yuri Gagarin was the first man in space on April 12, 1961) gave NASA a goal-defined mission—to land an American on the moon in the 1960s. While this task would never be more than 60 percent of NASA's overall effort, the Apollo program had to receive sustained executive, congressional, and public support necessary to achieve success.

Aside from being a new agency with a new mission and having to assume projects and facilities, new and old, NASA had to develop the ability to manage large-scale contracting of research and development. Unlike its predecessor agency NACA,[13] which had done most of its R&D in-house, 90 percent of NASA's annual expenditures by fiscal year 1962 went for goods and services procured from outside contractors. The Space Act gave NASA authority to develop, construct, test, and operate space vehicles and to contract for the conduct of this work with individuals, corporations, Government agencies, and others.[14] The method of conducting business led to the concept formulated in 1960 that NASA Centers should have sufficient in-house capability to allow them to conceive space flight development projects, develop technical specifications for private contractors, and supervise contractors to ensure high reliability of systems, subsystems, and components in their early development stages.

NASA was different in both method and goals from most other Government agencies. As a heavily mission-oriented R&D agency which sprang from a unique set of circumstances and was organized to achieve specific objectives, the management job that evolved for NASA was that of directing a substantial development program performed largely under contract with industry. A comparison with NACA illustrates just how much of a contracting agency NASA was. In 1958, NACA's budget was about $100 million and it employed about 8000 persons. In 1967, NASA's employment figure peaked at about 36 000, an increase of 450 percent. NASA annual expenditures exceeded $5 billion, an increase of 5000 percent. This almost

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NASA Historical Office, March 26, 1964 (copy in NASA Historical Archives); Robert C. Seamans, Jr., "Action and Reaction," 1969 Minta Martin Lecture, Massachusetts Institute of Technology, Cambridge, Mass.; Robert C. Seamans, Jr., "The Management of a National Space Program," speech delivered at the United Nations Conference on the Exploration and Peaceful Uses of Outer Space, Vienna, Austria, August 1968; Harold B. Finger and Albert F. Siepert, "NASA's Management of the Civilian Space Program," speech presented at the Sixteenth International Conference of the Institute for Management Sciences, March 26-28, 1969, New York; Harold B. Finger prepared testimony, Subcommittee on Science, Research and Development, Committee on Science and Astronautics, U.S. Congress, House, March 28, 1968.

[13] NACA's reputation was built almost entirely on in-house research capability. It had little experience in conceiving, planning, and executing large-scale projects requiring the teamwork of many persons and organizations and expenditure of large amounts of money, much of it through contracts.

[14] *National Aeronautics and Space Act of 1958, As Amended, and Related Legislation* (Washington, D.C.: NASA, Office of General Counsel, July 1, 1969), p. 7.

10-to-1 disparity in the increase in money compared to that in civil servants is a good indicator of the differing nature of the two agencies and their different ways of doing business. In its biggest total employment year (411 000 in 1965), NASA employed 34 300 (8.3 percent) in-house employees and 376 700 (91.7 percent) out-of-house contractor employees.[15]

The skills needed to manage such a program were different from those required by most Government agencies. And while NASA had some things in common with other large-scale Federal endeavors, the conditions and circumstances of its creation and early years were perhaps most formative in giving the agency its rather distinctive stamp. These conditions can be listed.[16]

First: The straightforwardness of the national charter granted by Congress and the nature of technology made for a clear-cut mission, with the knowledge that there would be little room for dispute concerning the mission's success or failure.

Second: When the United States decided to explore space, it was at least four years behind in propulsion capability, rather than only the four months which appeared to be the gap between *Sputnik I* and *Explorer I.*

Third: The new agency had no time to start from scratch. It immediately took over various on-going space projects initiated under the sponsorship of the Army, Navy, and Air Force. At the same time, it had to plan a coherent program and conceive new projects to ensure it could fully engage in a space endeavor that would serve the national interest.

Fourth: NASA acquired its initial staffing by wholesale transplants of established R&D teams throughout the Government; NACA intact (8000 employees), 200 from Project Vanguard and the Naval Research Laboratory, the Army's JPL, and the entire von Braun team (some 5000) from the U.S. Army. Also, key people were recruited from many governmental agencies.

Fifth: Very rapid budget increases created a special management challenge to ensure the programming of effective expenditures. The program doubled in size each of the first five years, and maintaining overall program balance while meeting the needs of Apollo proved a difficult challenge.

Sixth: NASA had to operate continuously under conditions of greater sustained stress and open publicity than any public or private R&D organization. By law, its program was largely open and unclassified.

As stated, the many unusual scientific, technological, and management challenges encountered by NASA during its early years made it an agency different from most.[17] To begin with, NASA displayed an uncommon unity of general management. Under the second Administrator–James E. Webb, who ran NASA for nearly eight years–the agency's top three managers became an exceptional example of complementary and interlocking roles, rather than multilevel management.[18] Upon his appointment, Webb retained

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[15] All of the above financial and personnel figures are contained in Chapters Three and Four of this volume and their sources are cited there.

[16] Siepert and Finger, "NASA's Management," pp. 2-4.

[17] See Webb, *Space Age Management,* a series of lectures given by the former NASA Administrator that offers his view from the top.

[18] Siepert and Finger, "NASA's Management," pp. 4-6.

Dr. Hugh L. Dryden and Dr. Robert C. Seamans, Jr., as Deputy Administrator and Associate Administrator, and merged their talents by working arrangements which intimately involved all three men, often called a "troika," as an entity in determining the key decisions of the agency.[19] Also the Office of Manned Space Flight evolved an elaborate system to manage the Apollo portion of the overall NASA system. Thus the wide range of specialized skills in public management, science, and technology was interlocked. Dr. Dryden was to leave the scene in 1965, and the Apollo 204 fire in January 1967 was to test the NASA structure severely.

NASA's survival as an effective agency depended upon a predictable repetitive excellence in its mission performance.[20] In a word, nothing short of success could be tolerated. Thus under Webb the agency employed an extensive documentation system to establish traceability that engineering specifications and technical management decisions had been implemented properly. The agency also employed an open loop communications system which ensured that no change in any critical system was undertaken without full communication to every other element that might be affected. Identification of key problems led to the gearing up of the best-informed people in NASA and, in the contractor echelon, to proposals of the best solutions. And, finally, NASA sought to identify every possible contingency and often devised a workable solution in advance. This literally became the way of life for most of NASA's personnel, admittedly not perfect, but necessarily geared to the achievement of the difficult and complex tasks required.

NASA Resources

Aside from recounting the space accomplishments of NASA, a dramatic example of the agency's life-style during its first 10 years is provided by a simple comparison of NASA as an institution at its inception and NASA at its peak.

NASA's first budget under President Eisenhower for fiscal year 1959 was $330.9 million, reflecting a few add-ons to NACA's budget.[21] For fiscal year 1961 it remained under $1 billion, as NASA's post-Mercury proposals were not approved by the Bureau of the Budget. Congress, after accepting President Kennedy's manned lunar landing goal for the decade, was requested to increase NASA money amounts substantially, and the fiscal year 1965 NASA appropriations total reached its pinnacle with $5.250 billion. A steady trail-off subsequently began and by fiscal year 1968 the appropriations total was $4.589 billion. This figure fell well under $4 billion in more recent years.

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[19] Webb subsequently stated: "The three of us decided *together* that the basis of our relationship should be an understanding that we would hammer out the hard decisions *together* and that each would undertake those segments of responsibility for which he was best qualified. In effect, we formed an informal partnership within which all major policies and programs became our joint responsibility, but with the execution of each policy and program undertaken by just one of us." See Webb Foreword in Rosholt, *Administrative History of NASA*, p. iv.

[20] Siepert and Finger, "NASA's Management," pp. 20-25.

[21] The NASA financial data are contained in Chapter Four of this volume and the sources are cited there.

During the first 10 years, nearly $32.5 billion was appropriated to the agency and just over $32 billion was actually spent. In effect, the agency generally received most of what it asked for. It received annually about 95 percent of its budget requests during its first 10 years. The bulk of these appropriations was allocated for research and development, with that category accounting for a low of nearly 60 percent of the total appropriations in fiscal year 1959 and a high of 87 percent in fiscal year 1966. The average R&D 10-year percent total was 79.7 percent. The categories of Administrative Operations and Construction of Facilities accounted for the remaining percentages.[22]

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[22] The three major segments of the NASA budget are Research and Development (R&D), Construction of Facilities (CoF), and Administrative Operations (AO). AO was changed to Research and Program Management (R&PM) after 1968.

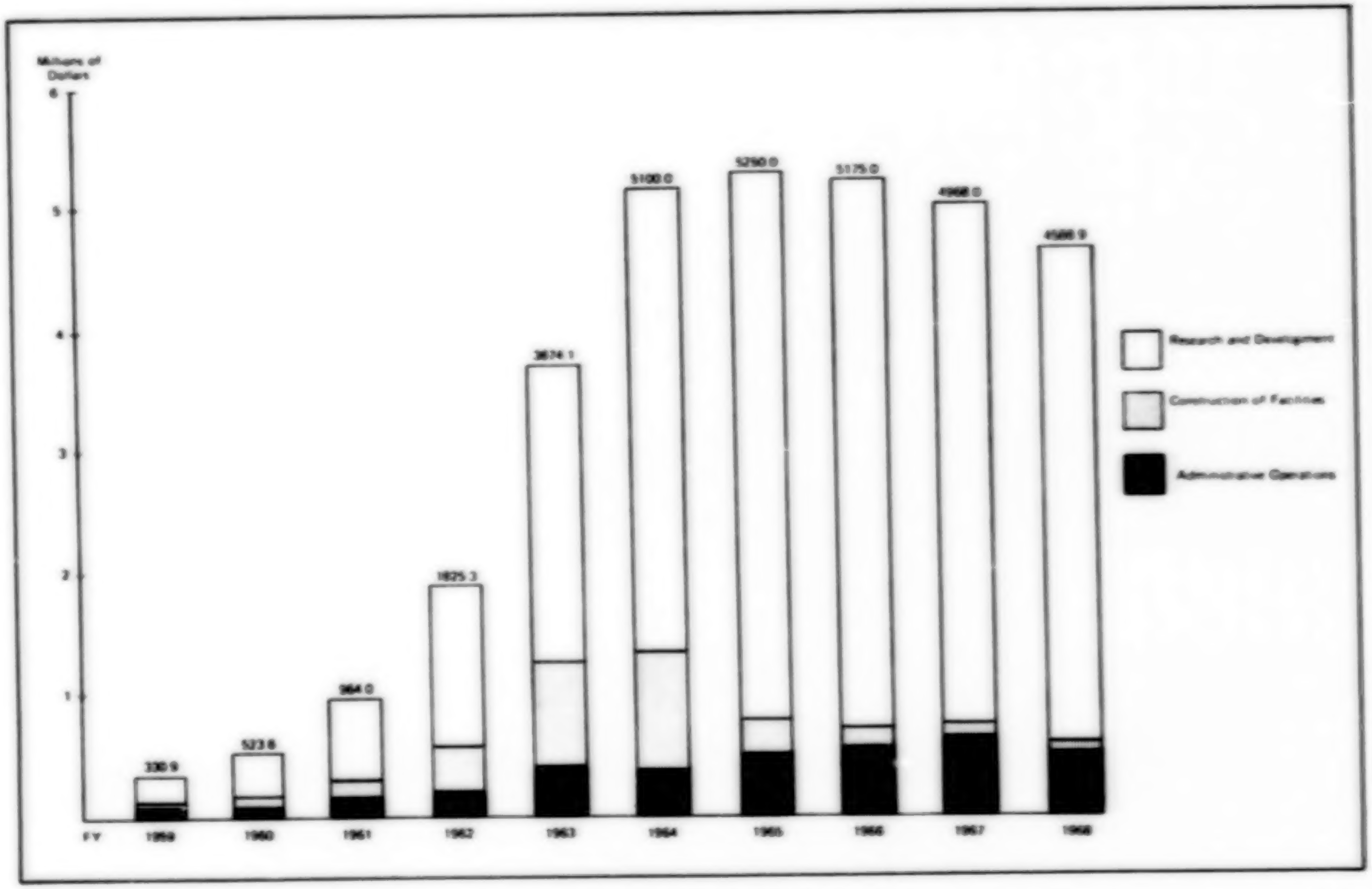

Figure 1-1. NASA Appropriations Summary by Fiscal Year.

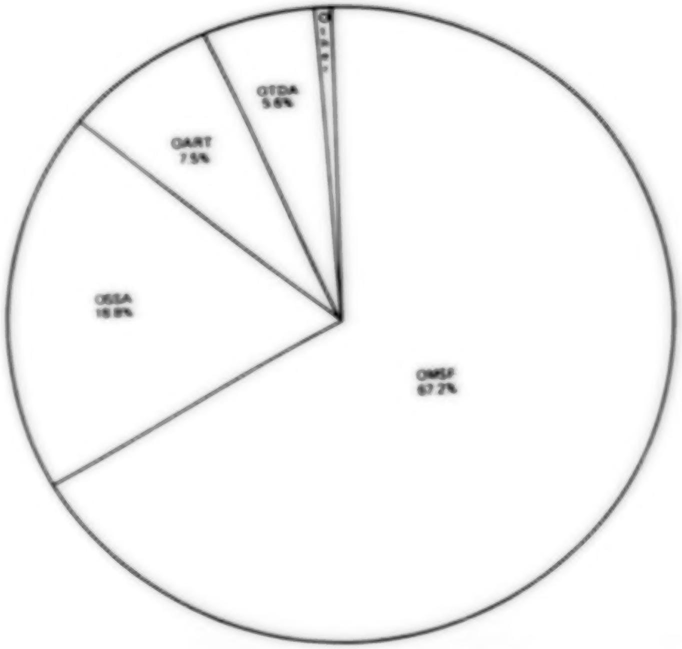

Figure 1-2. FY 1958-1968 R&D Obligation Totals by NASA Program Office.

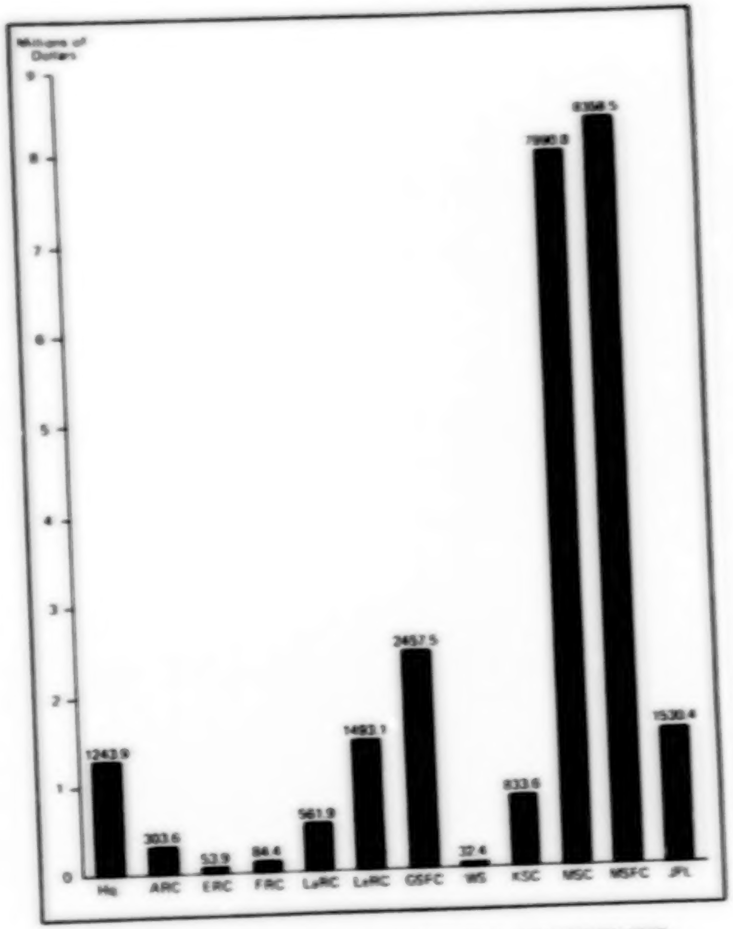

Figure 1-3. R&D Expenditure by NASA Installation FY 1958-FY 1968.

An R&D expenditures comparison among NASA's four major offices reveals the Office of Manned Space Flight obligated the greatest percentage of the 10-year budget with its 67.2 percent–contrasting with 18.8 percent for the Office of Space Science and Applications, 7.5 percent for the Office of Advanced Research and Technology, and 5.6 percent for the Office of Tracking and Data Acquisition.

A similar 10-year R&D expenditures comparison among NASA's 11 installations reveals Marshall Space Flight Center with the largest 10-year obligations total of $8.359 billion; more than half ($5.083 billion) this total was spent for development of the Saturn V launch vehicle. Nearly as much was obligated by the Manned Spacecraft Center–and, of its $7.901-billion 10-year total, about two thirds ($5.883 billion) was spent developing the Apollo spacecraft. The next largest total was that of Goddard Space Flight Center–$2.458 billion (only a portion of which was Apollo-related). All of the remaining Centers' totals slowly declined from that figure.

Most major construction was funded in the early years, with the fiscal years 1959-1964 Construction of Facilities appropriations total averaging 16.8 percent of the total appropriations, contrasting with the 2.2 percent of the years 1965-1968 when most construction was completed.

During its first decade, NASA built four major installations from the ground up (Goddard Space Flight Center, Manned Spacecraft Center, Kennedy Space Center, and Electronics Research Center) and tripled the number of field installations in six years. In its first 10 years, the agency spent $2.5 billion for the construction of facilities.[23] By far the largest total spent for construction at one Center during that time was the Kennedy Space Center's $898.2 million. The next largest total was the Mississippi Test Facility's $266.2 million.

By the end of 1968 NASA owned more than 57 500 hectares (142 000 acres) of land–whose total real property value exceeded $2.4 billion. And the total investment value (real and personal property, leasehold improvements, and work-in-progress) equaled $4.4 billion by June 30, 1968.

A comparison of 1958 resources with the 1968 status readily indicates the dramatic growth of the agency. Total real property value increased from $268.2 million in fiscal year 1959 to more than $2.4 billion in fiscal year 1968. Land value jumped from $668 thousand in fiscal year 1959 to more than $104 million in fiscal year 1968. And the number of hectares of land owned during the same period expanded from 2096 to 57 520 hectares (from 5179 to 142 134 acres).

Broken down by individual installations, Kennedy Space Center owned the largest number of hectares, 33 906 (83 783 acres), followed by Marshall Space Flight Center's holdings (which included the Michoud, MTF, and Slidell sites) of 9586 hectares (23 687.8 acres). The same two Centers led by far in real property value, with KSC totaling over $682 million for fiscal year 1968 and MSFC over $538 million for the same time.

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[23] For a comprehensive, detailed listing of NASA's technical facilities by Center, see *NASA Technical Facilities Catalog*, Vols. I-II (NHB 8800.5, March 1967).

NASA's personnel story was also one of 10 years of growth.[24] NACA employed 8000 persons when dissolved on September 30, 1958; NASA in-house employment peaked at about 36 000 in 1967, an increase of 450 percent. During NASA's first year, approximately one third of its 8000 employees were scientists and engineers. By 1968 nearly half of its total of 35 000 were serving as scientists and engineers. Naturally, as NASA's mission increased in complexity, the agency had to respond by upgrading its capabilities in the research and development areas.

Total employment (in-house and out-of-house) peaked in 1965 with about 411 000 employees. By 1968 this figure was down to about 246 200. Of the 1968 total, 88 percent (211 200) were out-of-house employees and 12 percent in-house (35 000). By 1971, total employment was down to about 150 000, with 122 000 out-of-house and 28 000 in-house.

As for distribution of permanent employees by installation, in 1958 Langley Research Center had the largest number (3458) of the then-existing four major Centers. This number accounted for about 42 percent of the NASA total. By the end of 1960, this top position went to Marshall Space Flight Center, which expanded to over 5000 employees with the transfer to NASA complete. Marshall held this position, possessing nearly 6400 employees (approximately 20 percent of the NASA total) by the end of 1968. During these years, however, other Centers grew remarkably also. By 1968, four NASA Centers had more than 4000 employees.[25]

A glance at the distribution of permanent civil service positions by NASA program office reveals the following shred-out as of 1968: OART 7871, OSSA 2989, OMSF 10 277, OTDA 1059, and administration and other support 10 226.

Aside from its own people in Headquarters and the field centers, NASA depended in great measure on outside contractors. NASA needed many unique services and products, and the Space Act of 1958 gave the agency the authority to contract for work with individuals, corporations, Government agencies, and others. After the May 1961 Apollo decision and subsequent congressional approval, the agency was able to greatly enlarge its physical plant and manpower resources. The scope of contracted work varied from feasibility studies for particular projects to the planning and construction of research facilities, even sometimes entire new installations.

The requirements for a successful Apollo program as well as a well-rounded overall program (which did not ignore space science, advanced research, aeronautics, and other important fields) were immense and demanded the full and proper use of all of the Nation's aerospace skills. Thus NASA procurement naturally skyrocketed as the space program was accelerated after 1961.

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[24] The NASA personnel data are in Chapter Three of this volume and the sources are given there.

[25] The four Centers were Goddard Space Flight Center, Langley Research Center, Lewis Research Center, and Manned Spacecraft Center.

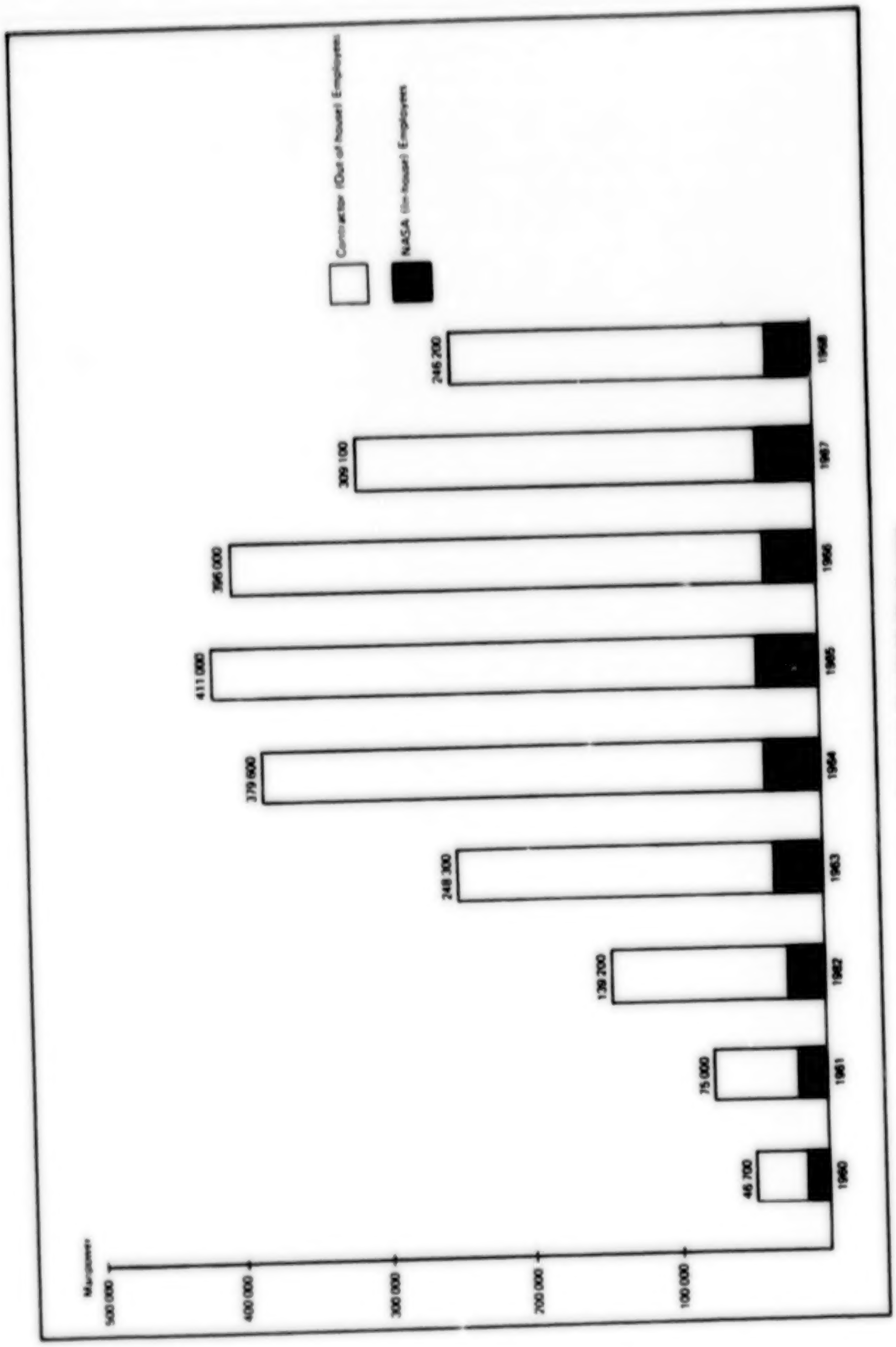

Figure 1-4. Total NASA Employment.

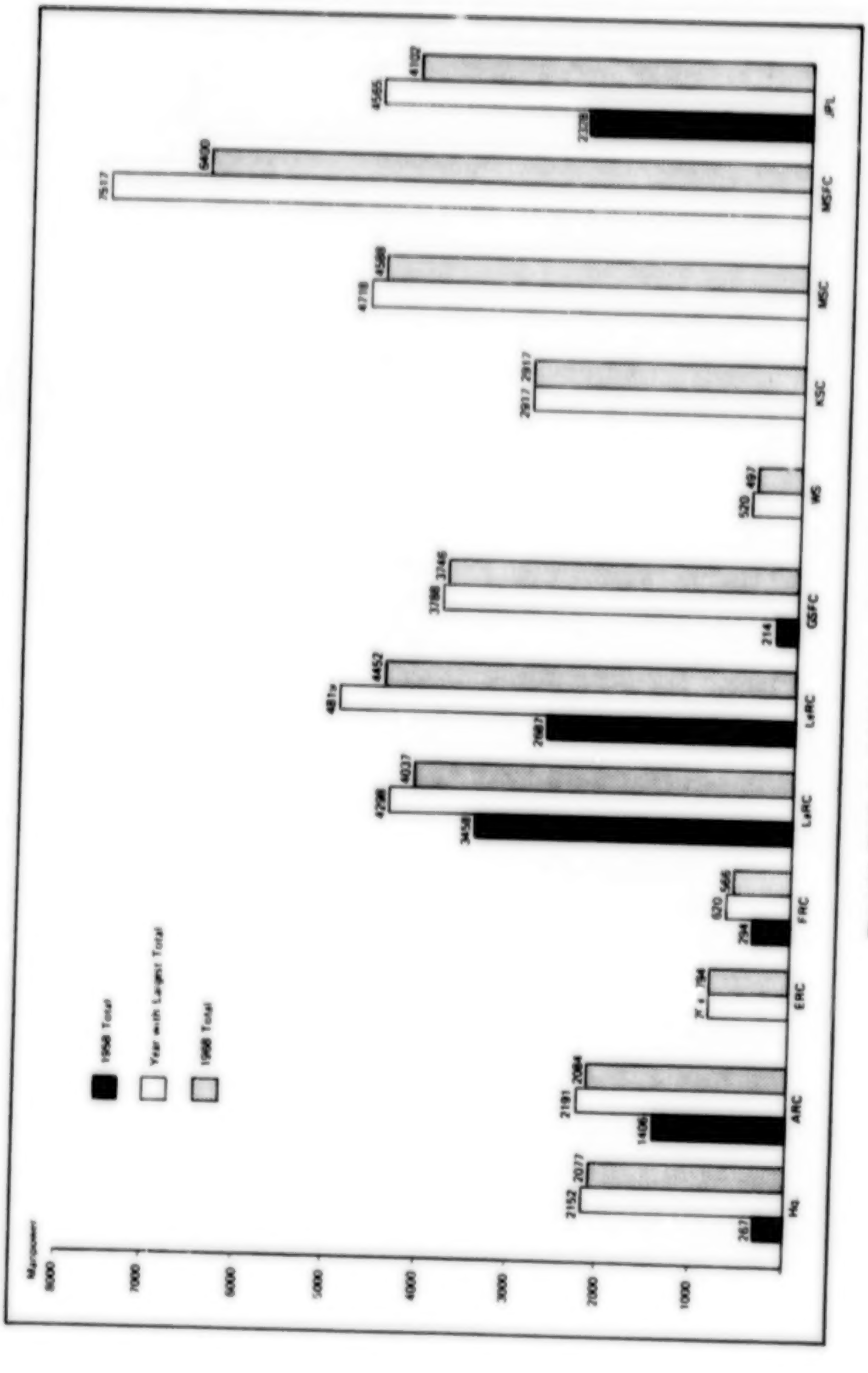

Figure 1-5. Distribution of NASA Employees by Installation (In-house).
Note: Centers with no solid bar were not technically in existence as of December 31, 1958.

The net value of NASA procurement rose from $756 million in fiscal year 1961 to $3.2 billion in fiscal year 1963, a 326.4 percent increase.[26] Since the number of procurement actions only doubled during those years, the average value of the procurement action increased considerably. The total net value reached its apex in fiscal year 1965, $5.2 billion.

An analysis of the distribution of NASA prime contract awards by states reveals California garnered over 43 percent of the 1961-1968 contract award dollar total. New York was second with 10 percent of the total. Most contracts were actually let by the individual centers, and the Marshall Space Flight Center and the Manned Spacecraft Center annually let by far the largest segments of the total. This proportion naturally reflected each Center's prime concern–Marshall built the Saturn V launch vehicle which sent MSC's Apollo spacecraft to the moon.

The top five individual contracts awarded, in terms of cumulative obligations as of March 1968, were:

1. to design, develop, and test the Apollo command and service modules (North American Rockwell Corp., Space Division);
2. to develop the Apollo lunar module (Grumman Aircraft Engineering Corp.);
3. to design, develop, and fabricate the S-IC stage of the Saturn V vehicle and provide launch support services (Boeing Co., Aerospace Division);
4. to design, develop, fabricate, and test the S-II stage of the Saturn V vehicle and provide launch support services (North American Rockwell Corp., Space Division);
5. to design, develop, and fabricate the S-IVB stage of the Saturn V vehicle and provide launch support activities (McDonnell Douglas Corp., Douglas Missile & Space Systems Division–which in June 1968 became part of McDonnell Douglas Astronautics Co., still a division of McDonnell Douglas Corp.)

In a ranking of NASA's top 10 contractors according to net value of awards over the years, North American Rockwell Corp. had been number one since fiscal year 1962. Grumman Aircraft Engineering Corp. had been in the top five since fiscal year 1964, along with the Boeing Co. And the combined record of the merged McDonnell Douglas Corp. showed only one year since 1962 in which one of the companies was not among the top six contractors.

Thus NASA's story has been one of many individuals, private corporations, Government agencies, and universities, each contributing. Only by discerning where the dollars went (over 90 percent went outside of the NASA program), and where the people worked, can the full history be appreciated.

By the end of the first decade of operation, the agency had undergone substantial change. Budgets had risen to nearly $6 billion a year and had dropped back to $4 billion, in-house personnel had peaked in 1967, and projects had been begun and completed as the base of the Apollo program was achieved. The agency had constructed new facilities from the ground up;

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[26] The NASA procurement data are given in Chapter Five of this volume and the sources are cited there.

expanded research in aeronautics and space science; orbited communications, meteorological, and international satellites of many sorts; sent probes to Mars and Venus; and constructed a new family of launch vehicles. And by the end of NASA's 10th year, the three *Apollo 8* astronauts had orbited the moon and returned to earth.

CHAPTER TWO

NASA FACILITIES

(Data as of 1968)

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CHAPTER TWO

NASA FACILITIES

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CHAPTER TWO
NASA FACILITIES

This chapter attempts to locate in time and space the $2.5 billion obligated for construction of NASA facilities between 1958 and 1968. Under Section 203 of the Space Act, NASA was directed:

> to acquire (by purchase, lease, condemnation, or otherwise), construct, improve, repair, operate, and maintain laboratories, research and testing sites and facilities. . .and such other real and personal property as the Administration deems necessary within and outside the continental United States. . . .

On August 27, 1958, the NASA FY 1959 supplemental appropriation (Public Law 85-766) made the first $25 million available for "Construction and Equipment" (C&E), the appropriation account that became in FY 1962 "Construction of Facilities" (CoF). The next day, August 28, the regular NACA appropriation was signed (Public Law 85-844), with an additional $23 million earmarked for construction. NACA was transferred to NASA on its establishment Oct. 1, 1958. Since the Space Act provided in Section 307 that sums appropriated "for the construction of facilities, or for research and development, shall remain available until expended," the 58 percent of construction and equipment funds still unobligated at the end of FY 1959 was carried over into FY 1960.

Periods and amounts in this continuing carryover system may be seen in Table 2-a. The carryover provision, along with legislation passed in 1959 permitting transfers of up to 5 percent from one appropriation account to another, contributed a good deal to NASA's funding flexibility. Although budgets, appropriations, obligations, and expenditures are examined in detail in Chapter Four, this summary budget history for construction funds is presented here as a reference point for patterns of growth that emerge in Tables 2-1 through 2-23.

On its first day of business, October 1, 1958, NASA inherited from the National Advisory Committee for Aeronautics its three research laboratories–Langley, Ames, and Lewis; two development stations–High Speed Flight Station at Edwards Air Force Base and Pilotless Aircraft Research Station at Wallops Island; and two liaison offices–one in California and the other at

Wright-Patterson Air Force Base in Ohio. By the end of December, Jet Propulsion Laboratory functions and facilities had been transferred from the U.S. Army to NASA. By the end of FY 1959, the first new NASA installation was under construction at Greenbelt, Maryland. Designated Goddard Space Flight Center, this facility was designed to accommodate NASA space flight programs, beginning with personnel transferred from the Naval Research Laboratory. Although the Ohio liaison office had been closed by June 30, 1959, NASA planned a substantial expansion of the California office and announced its evolution into the Western Operations Office later that summer.

These were NASA's installations at the end of its first (nine-month) fiscal year. As revealed in Table 2-1, they stood on 2095 hectares (5179 acres) of NASA-owned land and represented a real property value of just over $268 million. By the end of FY 1968, NASA's installations accounted for more than 57 465 hectares (142 000 acres) of owned land, and their total real property value had exceeded $2.4 billion. The total investment value of NASA facilities–comprising real and personal property, leasehold improvements, and work-in-progress–equaled $4.4 billion by June 30, 1968.

During its first 10 fiscal years NASA was to construct four field installations from the ground up: Goddard Space Flight Center (dedicated March 16, 1961); Manned Spacecraft Center near Houston, Texas (major occupancy in February 1964); John F. Kennedy Space Center, near Cape Kennedy, Florida (occupancy of Headquarters building in April 1965); and Electronics Research Center in Cambridge, Massachusetts (groundbreaking on November 2, 1966). Facilities in Huntsville, Alabama, of the Army Ballistic Missile Agency's Development Operations Division, transferred to NASA on July 1, 1960, were converted into a fifth major field installation, the George C. Marshall Space Flight Center. Component activities of Marshall–Michoud Assembly Facility in New Orleans with its Computer Operations Office in Slidell, Louisiana, and Mississippi Test Facility in Hancock County–were established in 1961 and 1962 along the inland water route from the Mississippi Delta to Huntsville. In another major construction project, NASA and the Atomic Energy Commission cooperated in building the Nation's test site for nuclear rockets, the Nuclear Rocket Development Station at Jackass Flats, Nevada (occupancy of Administration and Engineering Building on August 2, 1964).

In accordance with NASA's policy of contracting the bulk of its research and development work to be performed out-of-house, during its first 10 years NASA installed over $400 million worth of capitalized equipment in the plants of more than 20 000 prime and subcontractors. For its three tracking and data acquisition networks–Space Tracking and Data Acquisition Network, Manned Space Flight Network, and Deep Space Network–NASA equipped and inherited stations in North and South America, Europe, Africa, Australia, and on islands in the Atlantic and Pacific Oceans, and their real property value had reached $54.5 million by the end of FY 1968. In addition, the former NACA installations expanded during this period along with the newer Centers; an indication of their growth is given in Table 2-b.

This enormous facilities expansion reflects the evolution of the civilian portion of the national space program under NASA, one supported by annual

Table 2-a. Construction of Facilities: Obligations by Fiscal Year and Program Year

(in millions of dollars[a])

Program Year	Appro-priation	Change from Prior Year	Budget Plan[b]	Obligations by Fiscal Year										Total Obligations	Unobligated (as of 6/30/68)
				1959	1960	1961	1962	1963	1964	1965	1966	1967	1968		
1959	$ 48.0	----	$ 47.7	$20.1	$14.3	$ 8.2	$ 3.6	$ 0.5	$ 0.5	$ 0.2	$ *	$ 0.1	$ 0	$ 47.7	$ 0
1960	84.6	76.3%	98.4	----	69.2	21.7	5.5	1.1	0.7	0.3	-0.1	-*	0	98.3	.1
1961	122.8	45.1	124.9	----	----	65.3	52.5	4.1	1.2	1.0	0.5	.3	0	124.9	0
1962	316.0	157.4	356.1[c]	----	----	----	154.2	134.8	31.7	19.0	8.4	1.1	5.1	354.3	1.8
1963	776.2	145.6	766.2[d]	----	----	----	----	428.8	227.0	51.9	32.5	16.5	2.8	759.5	6.7
1964	680.0	-12.4	746.7	----	----	----	----	----	285.1	301.9	122.7	23.5	4.2	737.4	9.3
1965	262.9	-61.4	253.6[e]	----	----	----	----	----	----	147.8	78.4	10.0	8.9	245.1	8.5
1966	60.0	-77.1	59.1[f]	----	----	----	----	----	----	----	28.0	14.5	9.1	51.6	7.5
1967	83.0	38.3	86.2	----	----	----	----	----	----	----	----	50.0	21.4	71.4	14.8
1968	35.9	-56.7	33.4	----	----	----	----	----	----	----	----	----	13.0	13.0	20.4
			2572.3	20.1	83.5	95.2	215.8	569.3	546.3	522.1	270.4	115.9	64.5	2503.2	69.1
Pre-NASA			53.3[g]	17.9	6.2	3.0	1.3	0.5	0.3	0.1	----	*	0	29.3	24.0
Total			$2625.6[g]	$38.0	$89.7	$98.2	$217.1	$569.8	$546.6	$522.2	$270.4	$115.9	$64.5	$ 2532.5	$93.1

[a] Obligations amounts may not add to totals because of rounding.

[b] Budget plan figures include appropriations, transfers to and from administrative operations and research and development accounts or from other Government agencies, and unobligated balances brought forward from the previous year. Budget plan figures are not fixed and should be regarded from a reference point in time; those used in this table represent the plan as of June 30, 1968.

[c] Includes $16 000 reserve for claims.

[d] Includes $38 000 reserve for claims.

[e] Includes $750 000 reserve for claims.

[f] Includes $1 245 625 reserve for claims.

[g] Of this amount, $23 907 000 was obligated between 1953 and 1959 (pre-NASA).

*Less than $0.05 million.

Source: NASA, Office of Programming, Budget Operations Division, *History of Budget Plans, Actual Obligations, and Actual Expenditures for Fiscal Years 1959 Through 1963* (Washington: NASA, February 1965); NASA, Office of Administration, Budget Operations Division, "History of Budget Plans, Actual Obligations, and Actual Expenditures for Fiscal Years 1964 Through 1966" (draft manuscript, 1968); NASA, Financial Management Division, "Financial Status of Programs, Construction of Facilities," June 30, 1967; NASA, Financial Management Division, "Summary Financial Status of Programs," June 30, 1968; NASA, Budget Operations Division, "Status of Approved Programs, Construction of Facilities," FY 1959-FY 1968, June 1968.

Table 2-b. Investment Value of Former NACA Installations
1958 and 1968
(in thousands)

Installation[a]	NACA 1958 Plant Cost Estimate	NASA end of FY 1968 Total Investment Value
Langley Research Center	$125 975	$358 608
Ames Research Center	86 817	226 711
Lewis Research Center	119 500	385 733
Flight Research Center	16 585	42 819
Wallops Station	3 661	103 388

[a] Formerly Langley Aeronautical Laboratory, Ames Aeronautical Laboratory, Lewis Flight Propulsion Laboratory (all redesignated Oct. 1, 1958), High Speed Flight Station, and Pilotless Aircraft Research Station (both redesignated in 1959).

Sources: U.S. Congress, House, Hearings before Select Committee on Astronautics and Space Exploration, *Astronautics and Space Exploration*, 85th Cong., 2d sess. (Washington, D.C.: GPO, 1958), chart facing p. 404; NASA, Office of Facilities.

congressional decisions on the necessary means. Table 2-a shows that the largest annual percentage increase in both appropriation and budget plan during NASA's first 10 years occurred in FY 1962, although a larger net increase and appropriation total came the following year (see Figure 2-1). The FY 1962 budget submitted in January 1961, the last NASA budget submitted by the Eisenhower Administration, had requested $99.8 million for construction of facilities, some $23 million less than the FY 1961 appropriation. Under President Kennedy, NASA was directed to reevaluate the January budget, and a revised request added $19.2 million to construction funds. But on May 25, 1961, President Kennedy addressed Congress, asking that the United States commit resources to the goal of achieving a manned lunar landing before the end of the decade. He also urged accelerated development of a nuclear rocket and of communications and meteorological satellites. Congress approved this request, appropriating for FY 1962 a total of $316 million for construction of NASA facilities.

The impact of the lunar landing decision on facilities growth was seen first in land. Large increases at the end of FY 1962 in both land value and acreage may be attributed to land acquisition for John F. Kennedy Space Center, which began in late 1961 with funds reprogrammed from the research and development account. During FY 1963, KSC land was supplemented by property acquired by Lewis Research Center at Plum Brook Station and by Marshall's first acquisitions for the Mississippi Test Facility.

Proportional changes among the three variables that make up total real property value show certain trends during the 10 fiscal years (see Figure 2-2 and Table 2-2). As of June 30, 1959, value of buildings was over 90 percent of the total, while the value of other structures and facilities (such as storage tanks, gantries, launch pads; see definition of terms) was 8 percent and land value less than 1 percent. During the 10 years the proportion of buildings value to the total declined almost steadily, until June 30, 1968, the value of buildings was 53.9 percent of total real property value, while value of other structures and facilities increased to 41.8 percent of the total by the end of FY 1968.

Two other trends worth noting are the decline of leased property and work-in-progress. Table 2-1 shows a steadily decreasing leased property rental value and square footage, the result of occupancy of more NASA-owned buildings. Work-in-progress decreased since FY 1966, indicating completion of major projects and declining appropriations since the FY 1963 peak.

NASA's FY 1968 appropriation for construction of facilities was $35.9 million, $12.1 million less than that for its first fiscal year. Even if other evidence were lacking, this figure would suggest, not only that the Apollo program had reached the flight-test stage, but also that the Nation had not reached a decision on another goal comparable to that of sending Americans to the moon and back in the 1960s. Even when such decisions are reached, as the tables in Chapter Two reveal, long lead times are required before dollar decisions related to a suddenly accelerated program can be measured in terms of real and personal property.

The NASA Office of Facilities provided all figures for FY 1962 through FY 1968. This office, established as the Facilities Management Office in December 1965 under the Deputy Associate Administrator for Industry Affairs and transferred to the Office of Administration in March 1967, merged functions previously assigned to various Headquarters elements.*

As early as 1962, efforts began within the Procurement and Supply Division of the Office of Administration to set up a real estate recording and reporting system and a central repository for facilities data. This repository became part of the Facilities Management Office, and figures used in this chapter are supported by documents maintained there; they include title opinions, leases, agreements, easements, outgrants, real property records and transaction vouchers, master plans, and annual reports. Property tables prepared from these figures for Chapter Six were circulated for review at the installation level, where they were most often reviewed by the Real Property Accountable Officer responsible for maintaining detailed real property inventory records and reconciling property figures with installation financial accounts. The field installations also supplied figures for FY 1959 through

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*The office assumed principally responsibilities of the Construction Office, established August 26, 1963, under the Office of Industry Affairs, and the Facility Standards Division of the Office of Programming. The June 5, 1961, NASA reorganization had established an Office of Programs and, under it, an Assistant Director for Facilities. This title, changed in the November 1, 1961, reorganization to Director of Facilities Coordination, represented the first effort to centralize facilities management responsibilities for the anticipated expansion after the May decision to accelerate NASA's program. On November 1, 1963, the Office of Programs became the Office of Programming, with the Facility Standards Division replacing the Facilities Coordination Directorate. The Office of Programming was separated from the Office of Organization and Management group in the March 15, 1967, reorganization and was renamed the Office of Program Plans and Analysis. The Facilities Management Office was reorganized and renamed the Office of Facilities on May 22, 1968.

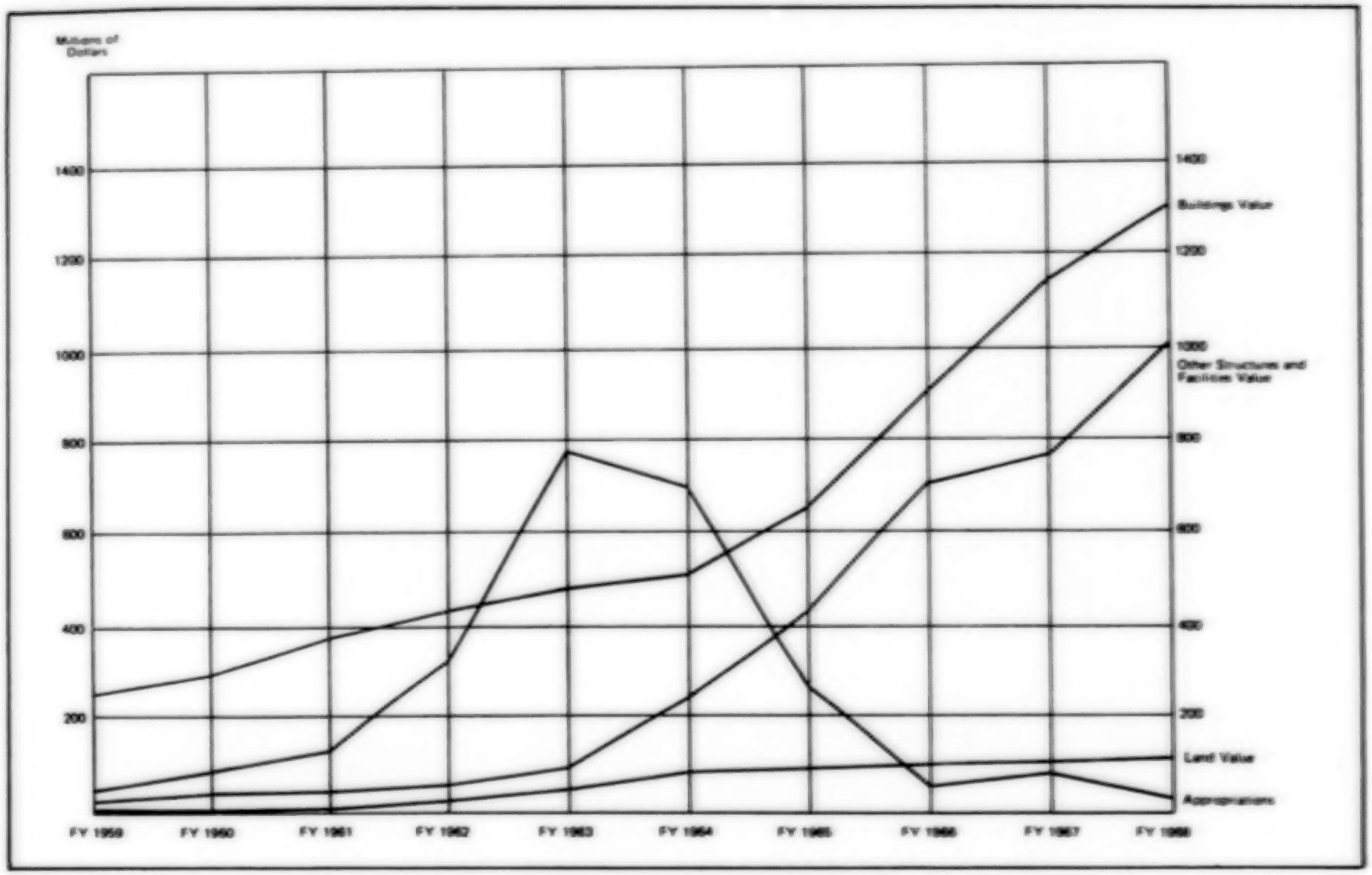

Figure 2.1. Value of Land, Buildings, and Other Structures and Appropriation Amounts by Fiscal Year.

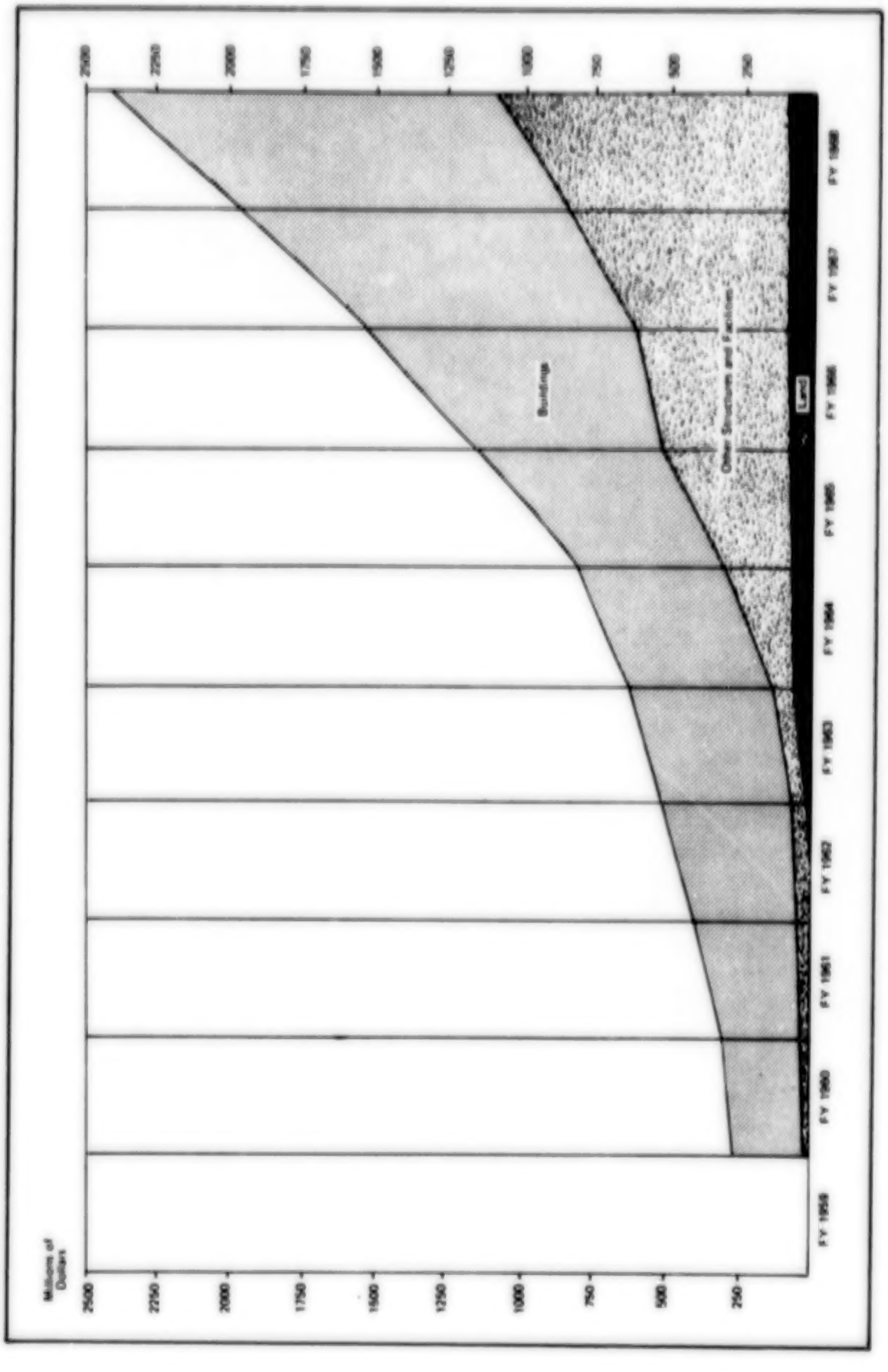

Figure 2.2. Components of Real Property Value.

FY 1961, when available. Property figures used here and in Chapter Six are thus the result of a cooperative effort of Headquarters and field installations.

Definition of Terms

Definitions of the terms used in this chapter were taken from NASA Management Instructions (NMIs) and NASA Handbook (NHB) *Approval of Facility Projects.*[1]

Buildings. Facilities with the basic function of enclosing usable space. This category of real property includes buildings leased by or on behalf of NASA and improvements to NASA-owned buildings and installed property but excludes leasehold improvements. (NMI 8800 1A)

Note: In the tables of this chapter and Chapter Six, square footage of buildings leased does *not* include GSA-leased buildings.

Component Installation. An installation, office, or other NASA organizational element which is located geographically apart from a NASA installation and which, pursuant to delegations from the Administrator, is assigned for management purposes to the Official-in-Charge of a Headquarters office, the Director of a field installation, or to an immediate subordinate of these officials (NMI 1132.2A).

Component installations of NASA Headquarters include:

NASA Pasadena Office
NASA Daytona Beach Operation

The AEC-NASA Space Nuclear Propulsion Office is organizationally under the NASA Headquarters Office of Advanced Research and Technology and may in some cases be regarded as a component installation.

Former component installations of NASA Headquarters were:

Western Support Office
Western Operations Office
Western Coordination Office
NASA Office–Downey
North Eastern Office

Component installations of Centers:

Marshall Space Flight Center–Michoud Assembly Facility with its Computer Operations Office; Mississippi Test Facility
Manned Spacecraft Center–White Sands Test Facility
Lewis Research Center–Plum Brook Station
Kennedy Space Center–Western Test Range Operations Division

Easement. An acquired privilege or right of use or enjoyment which one party may have in the land of another. For example, an easement or right-of-way for road or highway purposes, or for construction and maintenance of utility lines (NHB 7330.1, 26).

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[1] NASA, Office of Organization and Management, Administrative Services Division, NASA Management Instruction (NMI) 8800.1A and 1132.2A; NASA Handbook (NHB) 7330.1, *Approval of Facility Projects.*

Equipment. Personal property which meets all of the following criteria: (a) has an estimated service life of one year or more, (b) has an initial acquisition cost of $50 or more per unit, (c) retains its identity when put into use, and (d) will not be consumed during an experiment (NHB 7330.1, 26-27).

Collateral equipment. All nonintegral, severable equipment which is acquired for use, or used, in a facility. Collateral equipment is not required to make the structure or building useful and operable as a structure or building, but imparts to the facility its particular character at the time, for example, furniture in an office building or test equipment in a test stand (NHB 7330.1, 25). See *Personal Property.*

Integral equipment. That equipment which is normally required to make a facility useful and operable as a facility and which is built in or permanently affixed to it in such a manner that removal would impair the usefulness, safety, or comfort of the facility. Integral equipment would include such items as elevators, central air-conditioning systems, and electrical and plumbing fixtures and equipment (NHB 7330.1, 28). See *Installed Property.*

Note: As used in this chapter and Chapter Six, equipment refers to capitalized equipment only. (To be recorded as capital equipment, the equipment must have an estimated service life of more than one year, be identifiable as equipment when in use and not part of other equipment, generally cost $200 or more, and not be intended to be consumed in an experiment. Noncapitalized equipment is charged to the appropriate cost account, as "expensed equipment."[2])

Facility. A generic term used to encompass real property and related integral and collateral equipment of a capital nature; thus the term would not encompass operating materials, supplies, and noncapitalized equipment. The term "facility" is used in connection with land, buildings (facilities with the basic function of enclosing usable space), structures (facilities with the basic function of a research or operational tool or activity), and other real property improvements (NHB 7330.1,27).

Field Installation. A NASA organizational element located geographically apart from NASA Headquarters and headed by a Director. The following organizations are NASA field installations:

Ames Research Center
Electronics Research Center
Flight Research Center
George C. Marshall Space Flight Center
Goddard Space Flight Center
John F. Kennedy Space Center
Langley Research Center
Lewis Research Center
Manned Spacecraft Center
Wallops Station (NMI 1132.2A)

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[2] NASA, Office of Administration, Financial Management Division, *Financial Management Manual*, paragraph 9250-32a, 32b.

Jet Propulsion Laboratory is not a NASA field installation, but is operated by California Institute of Technology under contract to NASA.

AEC-NASA Space Nuclear Propulsion Office is not a NASA field installation, but reports to NASA Headquarters Office of Advanced Research and Technology.

Industrial Facility. NASA property which is contractor-held. In Table 2-3 figures for both real and personal property are given; other tables in Chapters Two and Six present figures for real property only. Figures for industrial property are included with NASA's in-house property in all tables, unless otherwise noted.

Installation. A NASA organizational element, including both Headquarters and field installations (NMI 1132.2A).

Installed Property. Items of fixtures and equipment normally required for the functional use of the building or structure, the removal of which would impair the usefulness, comfort, and safety of the building or structure. Installed property is included as part of the building or structure and accounted for accordingly. Examples of installed property items included as real property are plumbing fixtures and equipment, electrical and fixed fire protection systems, overhead crane runways, components which become part of a system, and other similar built-in or permanently affixed items (NMI 8800.1A). See *Equipment, Integral.*

Investment Value, Total. A figure representing the total of (a) real property value, including land, buildings, and other structures and facilities; (b) value of leasehold improvements; (c) value of capitalized equipment; and (d) work-in-progress. Value is based on cost plus improvements.

Note: As used in Chapter Two, total investment value includes both in-house and industrial (contractor-held) facilities.

Land. A category of real property that includes all acquired interests in land (for example, owned, leased, or acquired by permit) but excludes NASA-controlled easements and rights-of-way which are under leasehold improvements (NMI 8800.1A)

Note: As used in the tables of Chapters Two and Six, land includes only NASA-owned land unless otherwise noted. Figures presented for this variable do not include leased land or land held under use permit or agreement. NASA-owned land means Government-owned land for which NASA has custody and accountability.

Lease. An instrument conveying land, buildings, other structures or facilities or portions thereof for a specified term of time, in consideration of payment of a rental fee (NHB 7330.1, 28).

Leasehold Improvements. Improvements made by or on behalf of NASA to leased land, buildings, other structures and facilities; easements and rights-of-way (NMI 8800.1A).

Note: Although NASA Management Instruction 8800.1A deems leasehold improvements a category of real property, they are considered as a separate component of total investment value in Chapter Two.

Other Structures and Facilities. Category of real property which includes facilities with the basic function of research or operational tools or activities as distinct from buildings, which have the primary function of enclosing usable space. Includes all structures and facilities and installed property owned or leased by or on behalf of NASA; for example, storage tanks, gantry cranes, launch pads, blockhouses, airfield pavements, roads, monuments, sidewalks, parking areas, and fences. Excludes leasehold improvements (NMI 8800.1A).

Personal Property. Items of equipment which are installed in a building or structure to perform or assist in performing the operation housed within the buildings or structures and which, if removed, would retain their identity and usefulness as individual items of equipment; for example, a machine tool installed in a building (NMI 8800.1A). See *Equipment Collateral.*

Real Property. Land, buildings, structures, utilities systems and their improvements and appurtenances, permanently annexed to land. Real property includes equipment attached to and made a part of buildings, structures, and other facilities (such as heating systems), but excludes collateral equipment (such as machine tools) which is removable without significant damage to the real property (NHB 7330.1, 29).

Real property–when within the control of the United States or of any instrumentality, entity, or wholly-owned corporation of the United States–means any interest in land, excluding lands in the Public Domain or reserved or dedicated for National Forest or National Park purposes, and any fixture, structure, appurtenance, or other improvement permanently annexed to land, including lands to which the United States has no title or interest and lands in Public Domain or dedicated or devoted to National Forest or National Park purposes (NMI 8800.1A).

Note. In the tables of Chapters Two and Six total real property value is the sum of land value, buildings value, and other structures and facilities value. Leasehold improvements are not included in total real property value, but are considered as a separate component of total investment value.

Use Permit. A document conferring temporary permission to NASA to use land, buildings, structures, or other facilities for which another Government agency has custody and accountability.

NASA Installations and Abbreviations

For installation summaries, see Chapter Six.

Ames Research Center (ARC)
Electronics Research Center (ERC)
Flight Research Center (FRC)
Goddard Space Flight Center (GSFC)
John F. Kennedy Space Center (KSC)

Designated Launch Operations Center from July 1, 1962, until redesignation as KSC was announced Dec. 20, 1963.

Langley Research Center (LaRC)

Lewis Research Center (LeRC)

Figures for LeRC in Tables 2-5 through 2-21 include Plum Brook Station.

Manned Spacecraft Center (MSC)

Figures for MSC in Tables 2-5 through 2-21 include White Sands Test Facility.

Marshall Space Flight Center (MSFC)

MSFC totals used in Tables 2-4 through 2-21 include component installations and Huntsville.

Michoud Assembly Facility (MAF)

Designated Michoud Operations from December 1961 until July 1965.

Mississippi Test Facility (MTF)

Designated Mississippi Test Operations from December 1961 until July 1965.

Computer Operations Office (COO)

Space Nuclear Propulsion Office (SNPO)

Wallops Station (WS)

Pacific Launch Operations Office (PLOO)

Pacific Launch Operations Office was disestablished effective October 1, 1965.

Western Support Office (WSO)

NASA Western Coordination Office was redesignated Western Operations Office on August 5, 1959. Western Operations Office was disestablished June 15, 1966, and its functions were realigned in the NASA Office-Downey (a Headquarters component installation) and the Western Support Office established effective June 15, 1966. WSO was disestablished effective March 1, 1968.

Jet Propulsion Laboratory (JPL)

Not a NASA installation, but operated under the provisions of Contract NAS 7-100 (formerly NASw-6) between NASA and the California Institute of Technology.

NASA Headquarters (Hq.)

Table 2-1. Property: FY 1959-FY 1968
(as of June 30; money amounts in thousands)

Category	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
1. Total real property value	$268 210	$322 603	$407 692	$513 606	$614 194	$830 704	$1 172 392	$1 518 918	$1 996 267	$2 407 505
Percentage increase	---	20.3%	26.3%	25.9%	19.6%	35.3%	41.1%	29.6%	31.4%	20.6%
Land value	$ 668	$ 687	$ 887	$ 20 308	$ 47 700	$ 85 769	$ 91 397	$ 94 579	$ 99 218	$ 104 350
Percentage increase	---	2.8%	29.1%	2189.5%	134.9%	79.8%	6.6%	3.5%	4.9%	5.2%
Buildings value	$246 268	$286 025	$367 799	$435 069	$478 056	$506 149	$ 642 602	$ 902 108	$1 135 080	$1 298 187
Percentage increase	---	16.1%	28.5%	18.2%	9.9%	6.5%	26.2%	41.3%	24.9%	14.4%
Other structures and facilities value	$ 21 274	$ 35 991	$ 39 006	$ 58 229	$ 88 438	$235 786	$ 438 393	$ 516 231	$ 761 969	$1 004 963
Percentage increase	---	68.7%	8.6%	49.2%	51.9%	166.6%	85.9%	17.7%	47.6%	31.9%
Number of hectares of land (and acres)	2095.8 (5179)	3015.3 (7451)	3254.2 (8041)	9 050.0 (22 363)	32 171.2 (79 497)	47 663.2 (117 778)	49 931.7 (123 384)	57 653.8 (142 466)	57 731.8 (142 659)	57 519.7 (142 134)
Percentage increase	---	43.9%	7.9%	178.1%	255.5%	48.2%	4.8%	15.5%	(*)	(*)
Number of buildings	NA	NA	NA	NA	1117	1246	1484	1645	2182	2602
Percentage increase					---	11.5%	19.1%	10.1%	32.6%	19.2%
Number of sq meters of buildings (and sq ft)	471 132.2 (5 071 225)	511 154.0 (5 502 016)	705 772.0 (7 596 866)	1 051 693.8 (11 320 342)	1 232 704.4 (13 268 715)	1 516 780.6 (16 326 486)	1 930 374.0 (20 778 370)	2 376 222.4 (25 577 445)	2 706 058.4 (29 127 772)	2 883 691.1 (31 039 795)
Percentage increase	---	8.4%	38.0%	49.0%	17.2%	23.0%	27.2%	23.1%	13.9%	10.6%
2. Capitalized equipment value	NA	NA	NA	$185 979	$255 745	$356 799	$ 507 865	$ 954 948	$1 156 685	$1 418 152
Percentage increase					37.5%	39.5%	42.3%	88.0%	21.1%	22.6%
3. Leasehold improvements value	NA	NA	NA	NA	NA	NA	NA	$ 866	$ 938	$ 1062
Percentage increase								---	8.3%	13.2%
4. Work-in-progress value	NA	NA	NA	NA	NA	NA	NA	$1 176 401	$ 889 965	$ 585 555
Percentage increase								---	-24.4%	34.2%
5. Total investment value (1+2+3+4)	NA	NA	NA	NA	NA	NA	NA	$3 651 133	$4 043 854	4 412 274
Percentage increase								---	10.8%	10.9%
NASA leased property rental value	NA	NA	NA	NA	$ 4285	$ 2299	$ 911	$ 554	$ 458	$ 280
Percentage change					---	-46.4%	-60.4%	-39.2%	-17.4%	-38.9%
Number of hectares leased (and acres)	NA	NA	NA	92.1 (228)	4381.2 (10 826)	6621.2 (16 361)	6645.7 (16 422)	1182.4 (2922)	475.5 (1176)	1185.2 (2928)
Number of buildings leased	NA	NA	NA	NA	NA	NA	NA	3	10	7
Number of sq meters of buildings leased (and sq ft)	NA	NA	NA	66 910.3 (720 216)	131 081.1 (1 410 945)	83 682.6 (900 752)	38 875.6 (418 432)	15 310.1 (164 797)	14 076.3 (151 516)	9718.0 (104 604)

* = Less than 0.5 percent.

NA = Not available.

Source: NASA, Office of Facilities.

Table 2-2. Value of Real Property Components as Percentage of Total
(as of June 30; total real property value in thousands)

Component	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
Land	0.3%	0.2%	0.2%	4.0%	7.8%	10.3%	7.8%	6.2%	4.9%	4.3%
Buildings	91.8	88.7	90.2	84.7	77.8	61.3	54.8	59.8	56.9	53.9
Other structures and facilities	7.9	11.1	9.6	11.3	14.4	28.4	37.4	34.0	38.2	41.8
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total real property value	$ 268 210	$ 322 603	$ 407 692	$ 513 606	$ 614 194	$ 830 704	$1 172 392	$1 518 918	$1 996 267	$2 407 505

Source: Derived from Table 2-1.

Table 2-3. Industrial (Contractor-Held) Facilities
(as of June 30; money amounts in thousands)[a]

Category	1965	1966	1967	1968
1. Total real property value	$150 990	$136 166	$161 383	$205 518
Percentage increase	---	-9.9%	18.5%	27.3%
Land value	$ 6 291	$ 6 374	$ 8 779	$ 8 183
Buildings value	$ 71 854	$ 77 485	$ 98 830	$117 400
Other structures and facilities value	$ 72 845	$ 52 307	$ 53 774	$ 79 935
2. Leasehold improvements value	NA	$ 210	$ 276	$ 478
3. Plant equipment value	NA	$347 662	$401 086	$486 696
4. Work-in-progress value	NA	$ 46 593	$ 71 289	$ 34 940
Total investment value (1+2+3+4)	NA	$530 631	$634 034	$727 632
Percentage increase	---	---	(19.4%)	(14.8%)
Number of hectares owned (and acres)	127.5 (315)	1256.2 (3104)	4295.4 (10 614)	4295.4 (10 614)
Percentage increase	---	885.3%	241.9%	0%
Number of buildings	339	340	407	468
Number of sq meters of bldgs. (and sq ft)	1 449 867.6 (3 582 701)	1 414 680.2 (3 495 751)	1 545 229.0 (3 818 344)	1 675 351.2 (4 139 883)

[a] Industrial property figures are included in Table 2-1; data for earlier years are not available.

NA = Not available.

Source: NASA, Office of Facilities

Table 2-4. NASA Facilities Total Investment Value, FY 1966-FY 1968: In-house and Contractor-Held
(as of June 30; in thousands)[a]

Facility	Total Real Property Value			Percentage Increase Between 6/30/63 and 6/30/68	Leasehold Improvements			Plant Equipment		
	1966	1967	1968		1966	1967	1968	1966	1967	1968
NASA Headquarters[b]	$ 34 391	$ 32 412	$ 0		$ 0	$ 0	$ 0		$ 28 306	$ 8 175
Office of University Affairs	0	0	0		0	0	0		1 939	2 035
Total	34 391	32 412	0		0	0	0		30 245	10 210
Office of Manned Space Flight										
Kennedy Space Center	308 023	531 646	682 378	542.5%[c]	0	0	0	$ 64 307	94 240	127 900
Manned Spacecraft Center	131 940	167 023	217 227	875.4[c]	156	156	8	96 599	124 958	154 973
Marshall Space Flight Center	286 576	409 722	538 362	415.2	126	161	184	244 962	256 297	302 575
Total	726 539	1 108 391	1 437 967		282	317	192	405 868	475 495	585 448
Office of Advanced Research and Technology										
Ames Research Center	136 654	164 125	166 571	46.7	0	0	0	34 674	41 812	53 670
Electronics Research Center	739	769	2 779	----	0	0	0	1 808	6 961	13 227
Flight Research Center	8 778	9 312	9 527	86.9	0	0	0	29 230	29 522	32 332
Langley Research Center	204 725	235 285	249 588	58.7	0	0	0	64 540	83 212	91 240
Lewis Research Center	197 234	203 878	241 419	98.0	113	113	155	77 361	80 851	96 884
Space Nuclear Propulsion Office	16 016	23 111	24 915	----	0	0	0	7 728	24 075	24 408
Total	564 146	636 480	694 799		113	113	155	215 341	266 433	311 761
Office of Space Science and Applications										
Goddard Space Flight Center	91 012	111 234	132 040	845.8	263	230	307	199 031	258 184	371 696
NASA Pasadena Office (JPL)	47 175	48 620	78 771	218.1	206	272	408	79 252	92 093	103 796
Wallops Station	55 655	59 130	63 928	106.0	2	6	0	26 908	34 235	35 241
Total	193 842	218 984	274 889		471	508	715	305 191	384 512	510 733
NASA Total	$1 518 918	$1 996 267	$2 407 505	292.0%	$866	$938	$1062	$954 948	$1 156 685	$1 418 152

Table 2-4. NASA Facilities Total Investment Value, FY 1966-FY 1968: In-house and Contractor-Held (Continued)
(as of June 30; in thousands)[a]

Facility	Work-in-Progress 1966	Work-in-Progress 1967	Work-in-Progress 1968	Total Investment 1966	Total Investment 1967	Total Investment 1968	Percentage of NASA Total Investment 1966	Percentage of NASA Total Investment 1967	Percentage of NASA Total Investment 1968
NASA Headquarters									
Office of University Affairs	$ 21	$ 0	$ 0	$ 61 380	$ 60 718	$ 8 175	1.6%	1.5%	*
Total	0	0	0	1 580	1 939	2 035	*	*	*
	21	0	0	62 960	62 657	10 210	1.7	1.5	—
Office of Manned Space Flight									
Kennedy Space Center	439 648	322 720	240 231	811 978	948 606	1 050 510	22.2%	23.5	23.8%
Manned Spacecraft Center	85 500	59 332	48 670	314 195	351 469	420 878	8.6	8.7	9.5
Marshall Space Flight Center	394 946	261 177	104 452	926 610	927 357	945 573	25.4	22.9	21.4
Total	920 094	643 229	393 353	2 052 783	2 227 432	2 416 961	56.2	55.1	54.7
Office of Advanced Research and Technology									
Ames Research Center	24 874	4 844	6 470	196 202	210 781	226 711	5.4	5.2	5.1
Electronics Research Center	340	3 847	4 151	2 887	11 577	20 157	*	*	0.5
Flight Research Center	2 187	2 235	960	40 195	41 069	42 819	1.1	1.0	1.0
Langley Research Center	32 316	18 627	17 780	301 581	337 124	358 608	8.3	8.3	8.1
Lewis Research Center	54 250	69 672	47 275	328 958	354 514	385 733	9.0	8.8	8.7
Space Nuclear Propulsion Office	11 422	7 448	529	35 166	54 634	49 852	1.0	1.4	1.1
Total	125 389	106 673	77 165	904 989	1 009 699	1 083 880	24.8	25.0	24.5
Office of Space Science and Applications									
Goddard Space Flight Center	108 661	126 086	110 817	398 967	495 734	614 860	10.9	12.3	13.9
NASA Pasadena Office (JPL)	10 939	7 286	0	137 572	148 271	182 975	3.8	3.7	4.1
Wallops Station	11 297	6 691	4 220	93 862	100 061	103 388	2.6	2.5	2.3
Total	130 897	140 063	115 037	630 401	744 066	901 223	17.3	18.4	20.3
NASA Total	$1 176 401	$889 965	$585 555	$3 651 133	$4 043 854	$4 412 274			

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[a] Data for earlier years are not available.

[b] Real property figure was reported by Western Support Office; for breakdown, see section of Western Support Office in Chapter Six.

[c] Percentage increase over June 30, 1964

* = Less than 0.5 percent

Source: NASA, Facilities Management Office, *Facilities Data* (January 1968), p. III-2

Table 2-5. Land Owned by Installation and Fiscal Year in Hectares (and Acres)
(as of June 30)

Installation	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
Ames Research Center	15.9 (39.4)	15.9 (39.4)	15.9 (39.4)	46.6 (115.0)	46.6 (115.0)	46.6 (115.0)	91.4 (225.7)	91.4 (225.7)	147.9 (365.5)	147.9 (365.5)
Electronics Research Center	-----	-----	-----	-----	-----	-----	0	2.4 (6.0)	2.5 (6.3)	3.5 (8.8)
Flight Research Center	0	0	0	0	0	0	0	0	0	0
Goddard Space Flight Center	0	0	231.1 (571.0)	231.1 (571.0)[a]	224.2 (553.9)[a]	279.2 (689.9)[a]	288.7 (713.5)	3 728.6 (9 213.6)	3 728.6 (9 213.6)	4 857.3 (12 002.7)
Kennedy Space Center	-----	-----	-----	5 407.0 (13 361.0)	20 064.7 (49 581.0)	32 062.5 (79 228.0)	33 746.9 (83 390.6)	33 903.5 (83 777.4)	33 903.5 (83 777.4)	33 905.8 (83 783.0)
Langley Research Center	174.0 (430.0)	174.0 (430.0)	174.0 (430.0)	174.0 (430.0)	218.5 (540.0)	218.5 (540.0)	218.5 (540.0)	218.5 (540.0)	218.5 (540.0)	218.5 (540.0)
Lewis Research Center	130.5 (322.4)	137.1 (338.8)	140.6 (347.4)	141.3 (349.2)	2 561.7 (6 330.0)[b]	2 563.1 (6 333.5)[b]	2 653.1 (6 333.5)[b]	5 557.5 (13 733.1)	5 557.5 (13 733.1)	5 342.2 (13 201.0)
Manned Spacecraft Center	-----	-----	-----	0	0	655.6 (1 620.0)	655.6 (1 620.0)	655.6 (1 620.0)	655.6 (1 620.0)	722.8 (1 785.9)
Marshall Space Flight Center Total	-----	-----	654.4 (1617.0)	988.3 (2442.0)	7 063.7 (17 455.0)	9 123.7 (22 545.0)	9 586.0 (23 687.8)	9 586.0 (23 687.8)	9 586.0 (23 687.8)	9 586.0 (23 687.8)
Marshall Space Flight Center	-----	-----	654.4 (1617.0)[c]	654.4 (1617.0)[c]	722.8 (1 786.0)[c]	722.8 (1 786.0)	727.2 (1 797.0)	727.2 (1 797.0)	727.2 (1 797.0)	727.2 (1 797.0)
Michoud Assembly Facility	-----	-----	-----	333.9 (825.0)[d]	333.9 (825.0)	333.9 (825.0)	360.5 (890.8)	360.5 (890.8)	360.5 (890.8)	360.5 (890.8)
Mississippi Test Facility	-----	-----	-----	-----	6 001.5 (14 830.0)	8 061.3 (19 920.0)	8 492.7 (20 986.0)	8 492.7[e] (20 986.0)	8 492.7 (20 986.0)	8 492.7 (20 986.0)
Computer Operations Office	-----	-----	-----	-----	5.7 (14.0)	5.7 (14.0)	5.7 (14.0)	5.7 (14.0)	5.7 (14.0)	5.7 (14.0)
Space Nuclear Propulsion Office	-----	-----	0	0	0	0	0	0	0	0
Wallops Stations	1248.7 (3085.6)	2657.8 (6567.6)	2657.8 (6567.6)	2656.8 (6565.0)	2 655.1 (6 561.0)	2 655.1 (6 561.0)	2 655.1 (6 561.0)	2 655.1 (6 561.0)	2 676.5 (6 613.7)	2 676.5 (6 613.7)
Pacific Launch Operations Office	-----	-----	-----	0	0	0	0	-----	-----	-----
Western Support Office	NA	NA	NA	NA	NA	NA	67.2 (166.0)	1195.9 (2955.0)	1195.9 (2954.9)	-----
Jet Propulsion Laboratory	30.5 (75.2)	30.5 (75.2)	34.7 (85.8)	59.5 (146.9)	59.5 (146.9)	59.1 (145.9)	59.1 (145.9)	59.1 (145.9)	59.1 (145.9)	59.1 (145.9)
Total	2095.8 (5179.0)	3015.3 (7451.0)	3254.2 (8041.2)	9 050.0 (22 363.1)	32 171.2 (79 496.8)	47 663.2 (117 778.3)	49 931.7 (123 384.0)	57 653.8 (142 465.5)	57 731.8 (142 658.2)	57 519.7 (142 134.3)

[a] Adjusted figure; see Table 6-41 in Chapter Six.
[b] Adjusted figure; see Table 6-80 in Chapter Six.
[c] MSFC land was not reported.
[d] Adjusted figure; see Table 6-121 in Chapter Six.
[e] Adjusted figure; see Table 6-123 in Chapter Six.

NA = Not available.

Source: NASA, Office of Facilities.

Table 2-6. Land Leased by Installation and Fiscal Year in Hectares (and Acres)
(as of June 30)

Installation	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
Ames Research Center	0	0	0	0	0	0	0	0	0	0.5 (1.1)
Electronics Research Center	----	----	----	----	----	----	0	0	0	0
Flight Research Center	0	0	0	0	0	0	0	0	0	0
Goddard Space Flight Center	NA	NA	NA	49.0 (121.0)	49.0 (121.0)	49.0 (121.0)	169.6 (419.0)	469.5 (1160.0)	422.5 (1043.9)	490.5 (1211.9)
Kennedy Space Center	----	----	----	NA	NA	0.4 (1.0)	5.1 (12.5)	0.5 (1.3)	0.6 (1.4)	0.7 (1.7)
Langley Research Center	NA	NA	NA	NA	0	0.1 (0.2)	0.04 (0.1)	10.5 (26.0)	10.2 (25.3)	10.2 (25.3)
Lewis Research Center	0	0	0	0	4 289.9 (10 600.7)	5 730.7 (14 160.7)	5 776.8 (14 274.7)	6.1 (15.0)	6.1 (15.0)	5.9 14.6
Manned Spacecraft Center	----	----	----	8.1 (20.0)	8.1 (20.0)	194.3 (480.0)	0.8 (2.0)	0.8 (2.0)	0.7 (1.6)	----
Marshall Space Flight Center Total	----	----	25.9 (64.0)	25.9 (64.0)	25.9 (64.0)	25.9 (64.0)	25.9 (64.0)	25.9 (64.0)	25.9 (64.0)	667.6 (1649.7)
Marshall Space Flight Center	----	----	25.9 (64.0)	25.9 (64.0)	25.9 (64.0)	25.9 (64.0)	25.9 (64.0)	25.9 (64.0)	25.9 (64.0)	667.6 (1649.7)
Michoud Assembly Facility	----	----	----	0	0	0	0	0	0	0
Mississippi Test Facility	----	----	----	----	0	0	0	0	0	0
Computer Operations Office	----	----	----	----	0	0	0	0	0	0
Space Nuclear Propulsion Office	----	----	0	0	0	0	0	0	0	0
Wallops Station	NA	NA	NA	4.5 (11.0)	3.6 (9.0)	3.6 (9.0)	4.1 (10.0)	4.1 (10.0)	3.8 (9.6)	3.9 (9.8)
Pacific Launch Operations Office	----	----	----	0	0	0	0	----	----	----
Western Support Office	NA	NA	NA	NA	NA	611.5 (1 511.0)	657.6 (1 625.0)	659.3 (1629.0)	0	----
Jet Propulsion Laboratory	30.6 (75.5)	32.3 (79.8)	29.3 (72.6)	4.7 (11.5)	4.7 (11.5)	5.8 (14.3)	5.9 (14.4)	5.9 (14.4)	5.8 (14.3)	5.8 (14.3)
Total	NA	NA	NA	92.1 (227.5)	4 381.2 (10 826.2)	6 621.2 (16 361.2)	6 645.7 (16 421.7)	1182.4 (2921.7)	475.5 (1175.1)	1185.2 (2928.4)

NA = Not Available.

Source: NASA, Office of Facilities

Table 2-7. Buildings: Number Owned by Installation and Fiscal Year
(as of June 30)

Installation	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
Ames Research Center[a]	27	27	30	33	40	44	46	48	50	55
Electronics Research Center	---	---	---	---	---	---	0	0	0	0
Flight Research Center	NA	NA	NA	NA	5	8	18	21	19	33
Goddard Space Flight Center	---	NA	NA	NA	8	30	52	216	246	190
Kennedy Space Center	---	---	---	NA	39	64	114	201	524	611
Langley Research Center	NA	NA	NA	NA	106	82	90	96	96	101
Lewis Research Center	34	40	40	40	318	367	131	168	191	298
Manned Spacecraft Center	---	---	---	0	2	15	60	83	161	251
Marshall Space Flight Center Total	---	---	(161)	(158)	(166)	(167)	(220)	(214)	(254)	(326)
Marshall Space Flight Center	---	---	161	158	142	122	192	161	176	182
Michoud Assembly Facility	---	---	---	NA	21	19	23	31	32	33
Mississippi Test Facility	---	---	---	---	NA	22	NA	17	41	106
Computer Operations Office	---	---	---	---	3	4	5	5	5	5
Space Nuclear Propulsion Office	---	---	NA	NA	NA	NA	2	8	9	9
Wallops Station	NA	NA	NA	NA	258	278	270	356	358	385
Pacific Launch Operations Office	---	---	---	NA	11	11	14	---	---	---
Western Support Office	0	NA	NA	NA	NA	NA	280	83	85	---
Jet Propulsion Laboratory	102	114	122	142	164	180	187	151	189	343
Total	NA	NA	NA	NA	1117	1246	1484	1645	2182	2602

[a] See Table 6-14 in Chapter Six for further explanation of major number of buildings at Ames.

NA = Not available.

Source: NASA, Office of Facilities.

Table 2-8. Buildings: Thousands of Square Meters (and Square Feet) Owned by Installation and Fiscal Year
(as of June 30)

Installation	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
Ames Research Center[a]	NA	NA	NA	130.7 (1 407)	142.5 (1 534)	153.0 (1 647)	169.6 (1 826)	178.0 (1 916)	160.4 (1 726)	163.3 (1 758)
Electronics Research Center	----	----	----	----	----	----	0	0	0	0
Flight Research Center	NA	NA	NA	17.8 (191)	16.0 (172)	23.8 (256)	23.9 (257)	37.6 (405)	28.6 (308)	32.7 (352)
Goddard Space Flight Center	----	NA	NA	48.4 (521)	57.0 (613)	113.3 (1 219)	142.6 (1 535)	187.3 (2 016)	232.3 (2 501)	238.4 (2 566)
Kennedy Space Center	----	----	----	2.1 (23)	5.8 (62)	56.6 (609)	151.4 (1 630)	274.7 (2 957)	441.8 (4 756)	472.8 (5 089)
Langley Research Center	NA	NA	NA	186.6 (2 009)	183.2 (1 972)	122.6 (1 320)	123.7 (1 332)	137.6 (1 481)	161.0 (1 733)	177.0 (1 905)
Lewis Research Center	115.4 (1 242)	141.6 (1 524)	141.6 (1 524)	141.6 (1 524)	217.8 (2 344)	259.2 (2 790)	213.8 (2 301)	243.2 (2 618)	264.1 (2 843)	291.4 (3 137)
Manned Spacecraft Center	----	----	----	0	0.6 (6)	39.5 (425)	154.6 (1 664)	200.4 (2 157)	244.5 (2 632)	415.0 (4 467)
Marshall Space Flight Center Total	----	----	145.2 (1 563)	386.1 (4 156)	449.6 (4 839)	478.8 (5 154)	567.5 (6 109)	712.6 (7 671)	761.2 (8 194)	810.5 (8 724)
Marshall Space Flight Center	----	----	145.2 (1 563)	159.6 (1 718)	208.1 (2 240)	231.3 (2 490)	319.8 (3 442)	339.7 (3 655)	369.6 (3 978)	386.7 (4 163)
Michoud Assembly Facility	----	----	----	226.5 (2 438)	235.4 (2 534)	237.2 (2 553)	238.7 (2 569)	323.7 (3 484)	330.6 (3 459)	330.6 (3 559)
Mississippi Test Facility	----	----	----	----	NA	4.6 (49)	2.8 (30)	43.1 (464)	50.8 (547)	85.4 (919)
Computer Operations Office	----	----	----	----	6.0 (65)	5.8 (62)	6.3 (68)	6.3 (68)	10.2 (110)	10.2 (110)
Space Nuclear Propulsion Office	----	----	NA	NA	NA	NA	.5 (5)	17.0 (182)	17.2 (185)	17.2 (185)
Wallops Station	NA	NA	NA	72.7 (783)	86.7 (933)	167.3 (1 801)	93.5 (1 006)	103.3 (1 112)	103.8 (1 117)	105.9 (1 140)
Pacific Launch Operations Office	----	----	----	3.4 (36)	4.5 (48)	4.5 (48)	6.8 (73)	----	----	----
Western Support Office	NA	NA	NA	NA	NA	NA	165.7 (1784)	162.2 (1 746)	161.5 (1 738)	----
Jet Propulsion Office	40.7 (438)	43.9 (473)	54.4 (586)	62.3 (670)	69.3 (746)	98.2 (1 057)	116.7 (1 256)	122.3 (1 316)	129.5 (1 394)	159.5 (1 717)
Total	471.1 (5 071)	511.1 (5 502)	705.8 (7 597)	1 051.6 (11 320)	1 232.7 (13 269)	1 516.8 (16 326)	1 930.4 (20 778)	2 376.2 (25 577)	2 706.0 (29 127)	2 883.7 (31 040)

[a] See Table 6-14 in Chapter Six for figures based on redefinition.
NA = Not available.

Source: NASA, Office of Facilities.

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Table 2-9. Buildings: Thousands of Square Meters (and Square Feet) Leased by Installation and Fiscal Year (as of June 30)[a]

	1962[b]	1963	1964	1965	1966	1967	1968
Ames Research Center	0	1.2 (13)	1.2 (13)	1.2 (13)	0	0	1.5 (16)
Electronics Research Center	----	----	----	0	0	0	0
Flight Research Center	NA	0.7 (8)	NA	0.7 (7)	0.7 (8)	0	0
Goddard Space Flight Center	10.7 (115)	23.1 (249)	16.5 (178)	9.9 (106)	4.6 (49)	5.1 (55)	5.1 (55)
Kennedy Space Center	0.9 (10)	4.0 (43)	4.9 (53)	4.9 (53)	0.9 (10)	0.9 (10)	0.9 (10)
Langley Research Center	NA	0	0.1 (1)	0.7 (7)	0.1 (1)	0	0
Lewis Research Center	1.5 (16)	3.6 (39)	0	0	0	0	0
Manned Spacecraft Center	29.0 (312)	33.8 (364)	4.9 (53)	2.4 (26)	2.4 (26)	2.4 (26)	0
Marshall Space Flight Center Total	22.2 (239)	60.1 (647)	52.7 (567)	14.8 (159)	2.4 (26)	2.2 (24)	2.2 (24)
Marshall Space Flight Center	22.2 (239)	24.7 (266)	24.7 (266)	14.8 (159)	2.4 (26)	2.2 (24)	2.2 (24)
Michoud Assembly Facility	0	35.4 (381)	28.0 (301)	0	0	0	0
Mississippi Test Facility	----	0	0	0	0	0	0
Computer Operations Office	----	0	0	0	0	0	0
Space Nuclear Propulsion Office	NA	NA	NA	0	0	0	0
Wallops Station	0	0	0	0	0	0	0
Pacific Launch Operations Office	0	0	0	0	----	----	----
Western Support Office	2.[illegible] (28)	3.2 (34)	3.1 (33)	4.4 (47)	4.2 (45)	3.4 (37)	----
Jet Propulsion Laboratory	0	0	0	0	0	0	0
Total	66.9 (720)	131.1 (1411)[c]	83.7 (901)[d]	38.8 (418)	15.3 (165)	14.1 (152)	9.8 (105)

[a] Does not include GSA-leased buildings.

[b] Data for earlier years are not available.

[c] Includes 1300 sq m (14 000 sq ft) for North Eastern Office.

[d] Includes 279 sq m (3000 sq ft) leased for a Headquarters component.

NA = Not available.

Source: NASA, Office of Facilities.

Table 2-10. Real Property Value by Installation and Fiscal Year[a]
(as of June 30; in thousands)

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
Ames Research Center	$ 80 410	$ 82 678	$ 96 946	$107 819	$113 534[b]	$123 190[b]	$131 906[b]	$136 654	$ 164 125	$ 166 571
Electronics Research Center	----	----	----	----	----	----	0	739	769	2 779
Flight Research Center	NA	NA	NA	NA	5 097	6 842	7 035	8 778	9 312	9 527
Goddard Space Flight Center	----	NA	NA	NA	13 961	35 350	62 939	91 012	111 234	132 040
Kennedy Space Center	----	----	----	----	38 148	106 206	176 793	308 023	531 646	682 379
Langley Research Center	103 738	116 336	139 240	199 148	157 258	172 964	192 950	204 725	235 285	249 588
Lewis Research Center	63 915	101 725	101 338	101 633	121 911	155 422	197 242	197 234	203 878	241 419
Manned Spacecraft Center	----	----	----	NA	831	22 190	60 822	131 940	167 023	217 227
Marshall Space Flight Center Total	----	----	(36 818)	(40 037)	(104 610)	(129 063)	(210 580)	(286 576)	(409 722)	(538 362)
Marshall Space Flight Center	----	----	36 818	40 037	56 246	65 240	134 721	151 658	183 573	208 861
Michoud Assembly Facility	----	----	----	NA	40 972	38 956	49 650	79 985	92 608	94 965
Mississippi Test Facility	----	----	----	----	4 472	21 532	22 602	51 262	128 284	229 243
Computer Operations Office	----	----	----	----	2 920	3 335	3 607	3 671	5 257	5 293
Space Nuclear Propulsion Office	----	----	NA	NA	NA	NA	92	16 016	23 111	24 915
Wallops Station	NA	NA	NA	NA	31 026	42 978	50 749	55 655	59 130	63 927
Pacific Launch Operations Office	NA	NA	NA	NA	3 005	3 105	3 847	----	----	----
Western Support Office	NA	NA	NA	NA	NA	NA	36 290	34 391	32 412	----
Jet Propulsion Laboratory	10 519	12 081	16 243	21 922	24 813	33 394	41 147	47 175	48 620	78 771
Total	$268 210	$322 603	$407 692	$513 606	$614 194	$830 704	$1 172 392	$1 518 918	$1 996 267	$2 407 505

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[a] Real property total = land value + buildings value + other structures and facilities value. Although leasehold improvements are deemed a category of real property in NASA Management Instruction 8800.1A, this variable is not included in the real property totals of this table or the real property tables in Chapter Six. For FY 1966 and FY 1967 figures on leasehold improvements by installation, see Table 2-4.

[b] Adjusted figure; see Table 6-14 in Chapter Six.

NA = Not available.

Source: NASA, Office of Facilities.

Table 2-11. Land Value by Installation and Fiscal Year
(as of June 30; in thousands)

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
Ames Research Center	$ 20	$ 20	$ 20	$ 663	$ 663	$ 663	$ 773[a]	$ 773	$ 2 373	$ 2 372
Electronics Research Center	---	---	---	---	---	---	0	739	769	1 099
Flight Research Center	0	0	0	0	0	0	0	0	0	0
Goddard Space Flight Center	NA	NA	NA	NA	58	421	735	1 145	1 291	1 535
Kennedy Space Center	---	---	---	NA	32 670	55 653	60 117	60 487	60 487	60 516
Langley Research Center	110	110	110	110	116	116	116	116	116	116
Lewis Research Center	290	292	295	303	1 582	1 597[b]	1 617	1 618	1 975	1 696
Manned Spacecraft Center	---	---	---	0	0	3 810	4 157	5 446	5 418	9 015
Marshall Space Flight Center total	---	---	(86)	(86)	(11 217)	(22 115)	(17 330)	(19 321)	(21 762)	(26 591)
Marshall Space Flight Center	---	---	86	86	95	95	406	2 106	4 074	3 802
Michoud Assembly Facility	---	---	---	NA	6 598	6 598	7 137	7 380	7 481	7 502
Mississippi Test Facility	---	---	---	---	4 472	15 370	9 726	9 774	10 144	15 224
Computer Operations Office	---	---	---	---	52	52	61	61	63	63
Space Nuclear Propulsion Office	---	---	0	0	0	0	0	0	0	0
Wallops Station	NA	NA	NA	NA	592	592	592	592	611	611
Pacific Launch Operations Office	---	---	---	0	0	0	0	---	---	---
Western Support Office	NA	NA	NA	NA	NA	NA	5 158	3 540	3 617	---
Jet Propulsion Laboratory	117	117	267	807	802	802	802	802	799	799
Total	$668	$687	$887	$20 308	$47 700	$85 769	$91 397	$94 579	$99 218	$104 350

[a] Adjusted figure; see Table 6-14 in Chapter Six.
[b] Adjusted figure; see Table 6-80 in Chapter Six.

NA = Not available.
Source: NASA, Office of Facilities.

Table 2-12. Buildings Value by Installation and Fiscal Year
(as of June 30; in thousands)

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
Ames Research Center	$ 80 390	$ 82 658	$ 96 926	$107 156	$110 639[a]	$120 259[a]	$129 021	$133 769	$ 159 406	$ 161 816
Electronics Research Center	----	----	----	----	----	----	0	0	0	1 671
Flight Research Center	NA	NA	NA	NA	4 609	6 074	5 458	6 954	7 399	7 627
Goddard Space Flight Center	----	NA	NA	NA	13 022	32 141	44 358	58 074	68 948	81 064
Kennedy Space Center	----	----	----	NA	474	14 065	42 742	110 335	186 080	242 915
Langley Research Center	NA	NA	NA	NA	145 438	62 808	79 474	86 316	106 050	118 570
Lewis Research Center	57 553	89 971	89 566	89 743	99 102	132 732	111 023	150 573	161 394	179 834
Manned Spacecraft Center	----	----	----	NA	74	11 754	39 974	103 072	119 748	158 788
Marshall Space Flight Center Total	----	----	(36 160)	(39 233)	(73 677)	(82 027)	(108 468)	(162 027)	(226 059)	(252 101)
Marshall Space Flight Center	----	----	36 160	39 233	50 136	55 517	77 546	95 431	110 744	123 089
Michoud Assembly Facility	----	----	----	NA	21 290	23 044	27 391	52 352	62 140	63 212
Mississippi Test Facility	----	----	----	----	NA	617	687	11 337	48 795	61 394
Computer Operations Office	----	----	----	----	2 251	2 849	2 844	2 907	4 380	4 406
Space Nuclear Propulsion Office	----	----	NA	NA	NA	NA	71	14 207	14 525	19 680
Wallops Station	NA	NA	NA	NA	13 397	20 602	22 517	22 241	23 159	23 665
Pacific Launch Operations Office	----	----	----	NA	888	888	1 547	----	----	----
Western Support Office	NA	NA	NA	NA	NA	NA	26 077	25 845	23 769	----
Jet Propulsion Laboratory	6 709	7 239	10 631	14 658	16 736	25 799	31 872	34 695	38 543	50 456
Total	$246 268	$286 025	$367 799	$435 069	$478 056	$509 149	$642 602	$908 108	$1 135 080	$1 298 187

[a] Adjusted figure; see Table 6-14 in Chapter Six.

NA = Not available.
Source: NASA, Office of Facilities.

Table 2-13. Other Structures and Facilities Value by Installation and Fiscal Year
(as of June 30; in thousands)

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
Ames Research Center	NA	NA	NA	NA	$ 2 232[a]	$ 2 268[a]	$ 2 112[a]	$ 2 112	$ 2 346	$ 2 383
Electronics Research Center	----	----	----	----	----	----	0	0	0	9
Flight Research Center	NA	NA	NA	NA	488	768	1 577	1 824	1 913	1 900
Goddard Space Flight Center	----	NA	NA	NA	881	2 788	17 846	31 793	40 995	49 441
Kennedy Space Center	----	----	----	NA	5 004	36 488	73 934	137 201	285 079	378 948
Langley Research Center	NA	NA	NA	NA	11 704	110 040	113 360	118 293	129 119	130 902
Lewis Research Center	$ 6 072	$11 462	$11 477	$11 587	21 227	21 093	84 602	45 043	40 509	59 889
Manned Spacecraft Center	----	----	----	NA	757	6 626	16 691	23 422	41 857	49 424
Marshall Space Flight Center Total	----	----	(572)	(718)	(19 716)	(24 921)	(84 782)	(105 228)	(161 901)	(259 670)
Marshall Space Flight Center	----	----	572	718	6 015	9 628	56 769	54 121	68 755	81 970
Michoud Assembly Facility	----	----	----	NA	13 084	9 314	15 122	20 253	22 987	24 251
Mississippi Test Facility	----	----	----	----	NA	5 545	12 189	30 151	69 345	152 625
Computer Operations Office	----	----	----	----	617	434	702	703	814	824
Space Nuclear Propulsion Office	----	----	NA	NA	NA	NA	21	1 809	8 586	5 235
Wallops Station	NA	NA	NA	NA	17 037	21 784	27 640	32 822	35 360	39 516
Pacific Launch Operations Office	----	----	----	NA	2 177	2 217	2 300	----	----	----
Western Support Office	NA	NA	NA	NA	NA	NA	5 055	5 006	5 026	----
Jet Propulsion Laboratory	3 693	4 725	5 345	6 457	7 275	6 793	8 473	11 678	9 278	27 516
Total	$21 274	$35 891	$39 006	$58 229	$88 438	$235 786	$438 393	$516 231	$761 969	$1 004 968

[a] Adjusted figures; see Table 6-14 in Chapter Six.

NA = Not available.
Source: NASA, Office of Facilities.

Table 2-14. Capitalized Equipment Value by Installation and Fiscal Year
(as of June 30; in thousands)

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
Ames Research Center	$12 608	$13 335	$13 368	$ 15 120	$ 17 806	$ 22 955	$ 28 119	$ 34 674	$ 41 812	$ 53 670
Electronics Research Center	----	----	----	----	----	----	100	1 808	6 961	13 227
Flight Research Center	NA	NA	NA	6 000	9 093	14 444	22 172	29 230	29 522	32 332
Goddard Space Flight Center	NA	NA	NA	23 000	37 191	59 404	110 243	199 031	258 184	371 696
Kennedy Space Center	----	----	----	7 000	10 294	16 771	28 203	64 307	94 240	127 900
Langley Research Center	NA	NA	NA	25 000	33 314	46 583	55 288	64 540	83 212	91 240
Lewis Research Center	NA	12 479	15 891	21 691	26 836	30 867	40 510	77 361	80 851	96 884
Manned Spacecraft Center	----	----	----	3 800	11 104	19 312	35 623	96 599	124 958	154 973
Marshall Space Flight Center Total	----	----	45 000	51 000	64 676	84 149	103 240	244 962	256 297	302 575
Marshall Space Flight Center	----	----	(45 000)	NA	NA	NA	NA	(140 000)	(139 000)	(236 080)
Michoud Assembly Facility	----	----	----	NA	NA	NA	NA	NA	NA	41 338
Mississippi Test Facility	----	----	----	----	NA	NA	NA	NA	NA	24 846
Computer Operations Office	----	----	----	----	NA	NA	NA	NA	NA	311
Space Nuclear Propulsion Office	----	----	NA	NA	NA	NA	434	7 728	24 075	24 408
Wallops Station	NA	NA	NA	6 000	9 177	12 965	18 100	26 908	34 235	35 241
Pacific Launch Operations Office	----	----	----	NA	25	642	246	----	----	----
Western Support Office	----	----	----	----	194	155	201	22 465	22 943	----
Jet Propulsion Laboratory	10 322	12 335	18 220	26 028	34 300	46 894	62 873	79 252	92 093	103 796
NASA Headquarters	NA	NA	NA	1 340	1 735	1 658	2 513	6 083	7 302	10 210
Total	NA	NA	NA	$185 979	$255 745	$356 799	$507 865	$954 948	$1 156 685	$1 418 152

NA = Not available.

Source: NASA, Office of Facilities.

Table 2-15. Land Value as Percentage of Total Real Property Value by Installation and Fiscal Year
(as of June 30)

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
Ames Research Center	*	*	*	0.6	0.6	0.5	0.5	0.6	1.5	1.5
Electronics Research Center	---	---	---	---	---	---	0	100.0	100.0	40.1
Flight Research Center	0	0	0	0	0	0	0	0	0	0
Goddard Space Flight Center	---	NA	NA	NA	0.4	1.2	1.1	1.3	1.3	1.2
Kennedy Space Center	---	---	---	NA	85.6	52.4	34.0	19.6	11.4	8.9
Langley Research Center	0.1	*	*	*	0.1	0.1	0.1	*	*	*
Lewis Research Center	0.3	0.2	0.2	0.2	1.3	1.0	0.8	0.8	0.9	0.7
Manned Spacecraft Center	---	---	---	NA	0	17.1	6.8	4.1	3.3	4.2
Marshall Space Flight Center[a]	---	---	0.2	0.2	10.7	17.1	8.2	6.8	5.3	4.9
Space Nuclear Propulsion Office	---	---	0	0	0	0	0	0	0	0
Wallops Station	NA	NA	NA	NA	1.9	1.4	1.1	1.0	1.0	1.0
Pacific Launch Operations Office	---	---	---	NA	0	0	0	---	---	---
Western Support Office	NA	NA	NA	NA	NA	NA	14.2	10.2	11.2	---
Jet Propulsion Laboratory	1.1	1.0	1.6	3.7	3.3	2.4	1.9	1.7	1.6	1.0

[a] MFSC total only; for breakdown see Tables 6-125 through 6-128 in Chapter Six.

*= Less than 0.5 percent.

NA = Not available.

Source: Derived from Tables 2-10 and 2-11.

Table 2-16. Buildings Value as Percentage of Total Real Property Value by Installation and Fiscal Year
(as of June 30)

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
Ames Research Center	99.9[a]	99.9[a]	99.9[a]	99.4[a]	97.5	97.6	97.8	97.8	97.1	97.1
Electronics Research Center	---	---	---	---	---	---	0	0	0	60.5
Flight Research Center	NA	NA	NA	NA	90.4	88.8	77.6	79.2	79.5	80.0
Goddard Space Flight Center	---	NA	NA	NA	93.3	90.9	70.5	63.8	62.0	61.4
Kennedy Space Center	---	---	---	NA	1.2	13.2	24.2	35.8	35.0	35.6
Langley Research Center	NA	NA	NA	NA	92.5	36.3	41.2	42.2	45.1	47.5
Lewis Research Center	90.2	88.5	88.5	88.4	81.3	85.4	56.3	76.3	79.2	74.5
Manned Spacecraft Center	---	---	---	NA	8.9	53.0	65.7	78.1	71.7	73.1
Marshall Space Flight Center[b]	---	---	98.2	98.0	70.4	63.6	51.5	56.5	55.2	46.9
Space Nuclear Propulsion Office	---	---	NA	NA	NA	NA	77.2	88.7	62.8	79.0
Wallops Station	NA	NA	NA	NA	43.2	47.9	44.4	40.0	39.2	37.0
Pacific Launch Operations Office	---	---	---	NA	29.6	28.6	40.2	---	---	---
Western Support Office	NA	NA	NA	NA	NA	NA	71.9	75.2	73.3	---
Jet Propulsion Laboratory	63.8	59.9	65.5	66.9	67.4	77.3	77.5	73.5	79.3	64.1

[a] Includes other structures and facilities.

[b] MSFC total only; for breakdown see Tables 6-125 through 6-128 in Chapter Six.

NA = Not available.

Source: NASA, Office of Facilities.

Table 2-17. Other Structures and Facilities Value as Percentage of Total Real Property Value
by Installation and Fiscal Year
(as of June 30)

	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
Ames Research Center	NA	NA	NA	NA	1.9	1.9	1.7	1.6	1.4	1.4
Electronics Research Center	---	---	---	---	---	---	0	0	0	*
Flight Research Center	NA	NA	NA	NA	9.6	11.2	22.4	20.8	20.5	20.0
Goddard Space Flight Center	---	NA	NA	NA	6.3	7.9	28.4	34.9	36.9	37.4
Kennedy Space Center	---	---	---	NA	13.2	34.4	41.8	44.6	53.6	55.5
Langley Research Center	NA	NA	NA	NA	7.4	63.6	58.7	57.8	54.9	52.4
Lewis Research Center	9.5	11.3	11.3	11.4	17.4	13.6	42.9	22.9	19.9	24.8
Manned Spacecraft Center	---	---	---	NA	91.1	29.9	27.5	17.8	25.0	22.7
Marshall Space Flight Center[a]	---	---	1.6	1.8	18.9	19.3	40.3	36.7	39.5	48.2
Space Nuclear Propulsion Office	---	---	NA	NA	NA	NA	22.8	11.3	37.2	21.0
Wallops Station	NA	NA	NA	NA	54.9	50.7	54.5	59.0	59.8	62.0
Pacific Launch Operations Office	---	---	NA	NA	70.4	71.4	59.8	---	---	---
Western Support Office	NA	NA	NA	NA	NA	NA	13.9	14.6	15.5	---
Jet Propulsion Laboratory	35.1	39.1	32.9	29.4	29.3	20.3	20.6	24.8	19.1	34.9

[a] MSFC total only; for breakdown see Tables 6-125 through 6-128 in Chapter Six.

* = Less than 0.05 percent.

NA = Not available.

Source: NASA, Office of Facilities.

Table 2-18. Real Property Value of Installations Ranked as Percentage of NASA Total
(as of June 30)

Ranking / NASA Total	1963		1964		1965		1966		1967		1968	
	$614 194 000		$830 704 000		$1 172 392 000		$1 518 918 000		$1 996 267 000		$2 407 505 000	
1.	LaRC	25.6%	LaRC	20.8%	MSFC	18.0%	KSC	20.3%	KSC	26.6%	KSC	28.3%
2.	LeRC	19.9	LeRC	18.7	LeRC	16.8	MSFC	18.9	MSFC	20.5	MSFC	22.4
3.	ARC	18.4	MSFC	15.5	LaRC	16.5	LaRC	13.5	LaRC	11.8	LaRC	10.4
4.	MSFC	17.0	ARC	14.8	KSC	15.1	LeRC	13.0	LeRC	10.2	LeRC	10.0
5.	LOC[a]	6.2	KSC	12.8	ARC	11.3	ARC	9.0	MSC	8.4	MSC	9.0
6.	WS	5.1	WS	5.2	GSFC	5.4	MSC	8.7	ARC	8.2	ARC	6.9
7.	JPL	4.0	GSFC	4.3	MSC	5.2	GSFC	6.0	GSFC	5.6	GSFC	5.5
8.	GSFC	2.3	JPL	4.0	WS	4.3	WS	3.7	WS	3.0	JPL	3.3
9.	FRC	0.8	MSC	2.7	JPL	3.5	JPL	3.1	JPL	2.4	WS	2.7
10.	PLOO	0.5	FRC	0.8	WOO[b]	3.1	WSO	2.3	WSO	1.6	SNPO	1.0
11.	MSC	0.1	PLOO	0.4	FRC	0.6	SNPO	1.1	SNPO	1.2	FRC	0.4
12.	---	---	---	---	PLOO	0.3	FRC	0.6	FRC	0.5	ERC	0.1
13.	---	---	---	---	SNPO	*	ERC	*	ERC	*	---	---
		100.0%		100.0%		100.0%		100.0%		100.0%		100.0%

[a] Launch Operations Center (LOC) redesignated Kennedy Space Center (KSC) effective Dec. 20, 1963.

[b] Western Operations Office (WOO) functions realigned in Western Support Office (WSO) on June 15, 1966.

* = Less than 0.1 percent. Because of rounding, columns may not add to 100.0 percent.

Source: Derived from Table 2-10.

Table 2-19. Capitalized Equipment Value of Installations Ranked as Percentage of NASA Total
(as of June 30)

Ranking / NASA Total	1962		1963		1964		1965		1966		1967		1968	
	$185 979 000		$255 745 000		$356 799 000		$507 865 000		$954 948 000		$1 156 685 000		$1 418 152 000	
1.	MSFC	27.4%	MSFC	25.3%	MSFC	23.5%	GSFC	21.7%	MSFC	25.7%	GSFC	22.5%	GSFC	26.2%
2.	JPL	14.0	GSFC	14.5	GSFC	16.6	MSFC	20.3	GSFC	20.8	MSFC	22.2	MSFC	21.3
3.	LaRC	13.4	JPL	13.4	JPL	13.1	JPL	12.3	MSC	10.1	MSC	10.7	MSC	10.9
4.	GSFC	12.4	LaRC	13.0	LaRC	13.0	LaRC	10.8	JPL	8.3	KSC	8.1	KSC	9.0
5.	LeRC	11.7	LeRC	10.5	LeRC	8.6	LeRC	7.9	LeRC	8.1	JPL	7.9	JPL	7.3
6.	ARC	8.1	ARC	7.0	ARC	6.4	MSC	7.1	LaRC	6.8	LaRC	7.2	LeRC	6.8
7.	LOC[a]	3.8	MSC	4.3	MSC	5.5	KSC	5.5	KSC	6.7	LeRC	7.0	LaRC	6.4
8.	FRC	3.2	LOC[a]	4.0	KSC	4.7	ARC	5.5	ARC	3.6	ARC	3.6	ARC	3.9
9.	WS	3.2	FRC	3.6	FRC	4.0	FRC	4.3	FRC	3.1	WS	3.0	WS	2.5
10.	MSC	2.0	WS	3.6	WS	3.6	WS	3.5	WS	2.8	FRC	2.5	FRC	2.3
11.	Hq.	0.7	Hq.[b]	0.7	Hq.	0.4	Hq.	0.4	WSO	2.3	SNPO	2.1	SNPO	1.7
12.	---	---	WOO[c]	*	PLOO	0.1	SNPO	*	SNPO	0.9	WSO	2.0	ERC	0.9
13.	---	---	PLOO	*	WOO[c]	*	PLOO	*	Hq.	0.6	Hq.	0.6	Hq.	0.6
14.	---	---	---	---	---	---	WOO[c]	*	ERC	0.2	ERC	0.6	---	---
15.	---	---	---	---	---	---	ERC	*	---	---	---	---	---	---
		100.0%		100.0%		100.0%		100.0%		100.0%		100.0%		100.0%

[a] Launch Operations Center (LOC) redesignated Kennedy Space Center (KSC) effective Dec. 20, 1963.

[b] Including North Eastern Office.

[c] Western Operations Office (WOO) functions realigned in Western Support Office (WSO) June 15, 1966.

* = Less than 0.1 percent. Because of rounding, columns may not add to 100.0 percent.

Source: Derived from Table 2-14 above.

Table 2-20. NASA Industrial (Contractor-Held) Real Property Value by Installation: FY 1967 and FY 1968 (as of June 30)[a]

Installation	Land in Hectares (and acres)		Number of Buildings		Buildings, Sq. Meters (and sq. feet)		Land Value (in thousands)		Buildings, Value (in thousands)		Other Structures & Facilities, Value (in thousands)		Total Real Property Value (in thousands)	
	1967	1968	1967	1968	1967	1968	1967	1968	1967	1968	1967	1968	1967	1968
Marshall Space Flight Center	0	0	32	34	43 089.5 (463 812)	44 403.5 (477 955)	$3979	$3707	$20 979	$20 492	$33 275	$42 778	$ 58 233	$ 66 977
NASA Pasadena Office[b]	59.1 (145.9)	59.1 (145.9)	189	343	129 490.4 (1 393 823)	159 577.6 (1 717 464)	799	799	38 543	50 607	9 278	27 517	48 620	78 923
Western Support Office	1 195.9 (2 954.9)	----	85	----	161 449.4 (1 737 822)	----	3617	----	23 769	----	5 026	----	32 412	----
Langley Research Center	44.5 (110.0)	44.5 (110.0)	1	1	2 275.2 (24 490)	6 130.7 (65 990)	6	6	10 658	15 177	25	25	10 689	15 208
Lewis Research Center	2 992.6 (7 395.4)	2 780.6 (6 871.1)	31	23	10 020.3 (107 858)	8 957.0 (96 412)	378	99	2 317	4 228	5 682	4 019	8 377	8 346
Wallops Station	0	0	68	68	8 402.5 (90 443)	8 402.5 (90 443)	0	0	2 258	2 557	270	271	2 828	2 828
SNPO-Cleveland	0	0	0	0	0	0	0	0	0	0	125	125	125	125
Manned Spacecraft Center[c]	0	67.2 (165.9)	1	83	8.9 (96)	160 537.6 (1 728 013)	0	3570	6	23 941	93	5 092	99	32 603
Goddard Space Flight Center[d]	1 128.7 (2 789)	1 128.7 (2 789.0)	NA	3	NA	218.5 (2 352)	NA	0	NA	88	NA	45	NA	133
Total	4 292.2 (10 606.2)	4 080.1 (10 081.9)	407	555	254 735.8 (3 818 344)	388 207.3 (4 178 629)	$8779	$8183	$98 830	$117 090	$53 774	$79 872	$161 383	$205 143

[a] Included in real property figures in Table 2-1. Figures are installation totals; for breakdown, see section on each installation in Chapter Six. Data for earlier years are not available.

[b] Jet Propulsion Laboratory, operated under contract with California Institute of Technology. FY 1968 figures include all DSN tracking stations.

[c] Transfer from WSO to MSC of NASA Industrial Plant-Downey is reflected in FY 1968 figures.

[d] Transfer from WSO to GSFC of TRW-Redondo Beach facility and the antenna test range at White Sands Missile Range operated by New Mexico State University is reflected in FY 1968 figures.

NA = Not available.

Source: NASA, Office of Facilities.

Table 2-21. Industrial (Contractor-Held) Real Property Value as Percentage of Total by Installation: FY 1967 and FY 1968 (as of June 30) [a]

Installation	Percentage of Installation Total							
	Land Value		Buildings Value		Other Structures and Facilities Value		Real Property Value	
	1967	1968	1967	1968	1967	1968	1967	1968
Marshall Space Flight Center	18.2	13.9	9.2	8.1	20.6	16.5	14.3	12.4
NASA Pasadena Office[b]	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Western Support Office	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Langley Research Center	5.2	5.2	10.1	12.8	*	*	4.5	6.1
Lewis Research Center	19.1	5.8	1.4	2.4	14.0	6.7	4.1	3.9
Wallops Station	0	0	11.0	10.8	6.5	6.4	4.8	4.4
SNPO–Cleveland	0	0	0	0	1.5	2.4	0.5	0.5
Manned Spacecraft Center	0	39.6	*	15.1	0.2	10.4	*	15.0
Goddard Space Flight Center	NA	0	NA	0.1	NA	0.1	NA	0.1

[a] For breakdown of industrial real property, see section on each installation in Chapter Six. Data for earlier years are not available.
[b] Jet Propulsion Laboratory, operated under contract with California Institute of Technology.

* = Less than 0.1 percent.
NA = Not available.

Source: Derived from Table 2-20.

Table 2-22. In-house Real Property at Tracking and Data Acquisition Stations: FY 1965-FY 1968
(as of June 30; in thousands)[a]

	1965	1966	1967	1968
Land	$ 32	$ 325	$ 325	$ 335
Buildings	3 725	11 842	13 438	15 910
Other structures and facilities	16 058	27 179	30 782	38 254
Total	$19 815	$39 346	$44 545[b]	$54 499

[a] In-house property includes Manned Space Flight Network (MSFN) and Space Tracking and Data Acquisition Network (STADAN); both MSFN and STADAN figures are included in Goddard Space Flight Center reports. Data for earlier years are not available.

[b] Does not include $1 753 000 for MSFN Goldstone station, for which inventory was in process as of June 30, 1967.

Source: NASA, Office of Facilities.

Table 2-23. NASA Industrial (Contractor-Held) Real Property at Deep Space Network Tracking and Data Acquisition Stations: FY 1967 and FY 1968
(as of June 30; in thousands)[a]

Location	Total Real Property Value	
	1967	1968
Goldstone, California	$ 5 622	$20 705
Woomera, Australia	2 424	2 424
Tidbinbilla, Australia	2 391	2 391
Robledo de Chavela, Spain	1 359	1 379
Cebreros, Spain	1 346	1 346
Hartebeesthoek, Republic of S. Africa	768	765
Total	$13 910	$29 010

[a] DSN property is included in NASA Pasadena Office (JPL) reports; data for earlier years are not available.

Source: NASA, Office of Facilities.

Table 2-24. Real Property at Tracking and Data Acquisition Stations by Location
(as of June 30; in thousands)[a]

Station Location	Year Became Operational	Network Affiliations[b]	Total Real Property Value				Remarks
			1965	1966	1967	1968	
Ascension Island	1967	MSFN	$ 0	$3104	$3104	$3 104	
Bermuda	1961	MSFN	132	1303	3173	3 157	
Blossom Point, Maryland	1956	STADAN	135	171	---	---	Prototype Minitrack station; phased out in Sept. 1966.
Canton Island	1961	MSFN	380	4165	4075	---	Phased out effective Dec. 31, 1967.
Carnarvon, Australia	1964	STADAN MSFN	0	1448	2527	2 527	
Corpus Christi, Texas	1961	MSFN	449	491	1777	1 782	
Cebreros, Spain	1967	DSN MSFN	0 0	0 0	1346 1468	1 346 2 768	
East Grand Forks, Minnesota	1960	STADAN	23	202	---	---	Phased out in June 1966.
Fairbanks, Alaska	1962	STADAN	1693	4070	4224	5728	Includes all Alaskan STADAN facilities (Ulaska and Gilmore; equipment at College site moved to Ulaska in late 1966).
Fort Meyers, Florida	1959	STADAN	135	194	259	565	Minitrack equipment transferred from Havana, Cuba.
Goldstone, California	1960	STADAN	1510	1745	1985	3153	STADAN site called Mohave; Minitrack equipment transferred from Brown Field Naval Auxiliary Station, Chula Vista, California.
		MSFN	0	0	1753[c]	1 932	
	1958	DSN	5361	5512	5622	20 721	Pioneer station operational in 1958; Echo site in 1960; Venus site in 1962; Mars site in 1966.
Grand Canary Island, Spain	1961	MSFN	455	515	515	3 115	
Guam	1967	MSFN	0	277	1960	1 960	

Table 2-24. Real Property at Tracking and Data Acquisition Stations by Location (Continued)
(as of June 30; in thousands)[a]

Station Location	Year Station Became Operational	Network Affiliations[b]	Total Real Property Value 1965	1966	1967	1968	Remarks
Guaymas, Mexico	1961	MSFN	$ 423	$ 662	$ 716	$ 938	
Hawaii (Kauai)	1961	MSFN	810	1000	2181	2 168	
Honeysuckle Creek (Canberra), Australia	1966	MSFN	0	0	2433	3 229	
Island Lagoon (Woomera), Australia	1961 1960	STADAN DSN	0 NA	278 NA	278 2424	NA 2 424	Smithsonian Astrophysical Observatory optical station established in 1957.
Johannesburg, Republic of South Africa	1960 1961	STADAN DSN	598 NA	903 NA	903 768	938 768	Minitrack equipment moved from Esselen Park (29 km [18 mi] nortneast of Johannesburg) to Hartebeesthoek (61 km [38 mi] northwest of Johannesburg) in 1960.
Kano, Nigeria	1961	MSFN	NA	496	---	---	Used for Mercury and Gemini programs; discontinued for Apollo program.
Lima, Peru	1957	STADAN	16	217	241	363	Former Minitrack station.
Orroral Valley, Australia	1965	STADAN	0	3076	3109	3 010	Minitrack equipment from Woomera site moved to Orroral Valley in late 1966.
Quito, Ecuador	1957	STADAN	748	1287	1191	1 657	Former Minitrack station.
Red Lake (Woomera), Australia	1961	MSFN	0	219	219	219	
Robledo de Chavela, Spain	1965	DSN	NA	NA	1359	1 379	
Rosman, North Carolina	1962	STADAN	5589	5815	6000	6 579	Second 26-m (85-ft.) dish antenna added Aug. 1964.
St. John's, Newfoundland	1960	STADAN	306	321	321	343	Former Minitrack station.
Santiago, Chile	1957	STADAN	1038	1441	1365	1 757	Former Minitrack station.
Tananarive, Malagasy Republic	1965-1966	STADAN	0	375	450	2 008	

Table 2-24. Real Property at Tracking and Data Acquisition Stations by Location (Continued)
(as of June 30; in thousands)[a]

Station Location	Year Station Became Operational	Network Affiliations[b]	Total Real Property Value				Remarks
			1965	1966	1967[c]	1968	
Tidbinbilla, Australia	1965	DSN	NA	NA	2391	2 391	
Toowoomba, Australia	1966	ATS	0	NA	NA	NA	Applications Technology Satellite station.
Winkfield, United Kingdom	1961	STADAN	14	59	71	159	Former Minitrack station.
Darwin, Australia		STADAN	---	---	---	---	Site on north coast of Australia; used for OGO.
Grand Bahama Island	1957	MSFN	---	---	---	---	Coral island 81 km (50 mi) east of Palm Beach, Fla.
Grand Turk Island	1957	MSFN	---	---	---	---	Former Minitrack station; phased out during July 1961.
Merritt Island, Florida		MSFN	---	---	---	---	Prime station during near-earth phases of Apollo missions.
Muchea, Australia		MSFN	---	---	---	---	After Mercury, station equipment moved to Carnarvon site.
Network Training Facility, Greenbelt, Maryland		STADAN	---	---	---	---	Contains equipment employed in various NASA networks for testing and training.
Point Arguello, California		MSFN	---	---	---	---	Located about 64 km (40 mi) northwest of Santa Barbara.
White Sands, New Mexico		MSFN	---	---	---	---	Used as a prime site during Mercury and Gemini; provided only C-band radar support during Apollo.

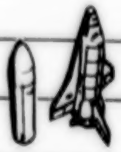
[a] Figures for STADAN and MSFN are included in Goddard Space Flight Center reports; DSN figures are included in NASA Pasadena Office (JPL) reports and represent industrial (contractor-held) real property. DSN real property inventory was in process on June 30, 1967, and figures were not included in some end-of-fiscal-year reports.

[b] MSFN = Manned Space Flight Network. STADAN = Space Tracking and Data Acquisition Network. DSN = Deep Space Network. ATS = Applications Technology Satellite station.

[c] Inventory was in process on June 30, 1967; this figure was not included in end-of-fiscal-year reports and is not included in Table 2-22.

NA = Not Available.

Source: NASA, Office of Facilities; NASA, Office of Tracking and Data Acquisition; William R. Corliss, *The Evolution of the Satellite Tracking and Data Acquisition Network (STADAN)*, GHN-3 (Greenbelt, Md.: GSFC, January 1967), p. 57 ff.; Corliss, "Histories of STADAN, the MSFN, and NASCOM," unpublished comment draft, June 1, 1972, Appendix A.



CHAPTER THREE

NASA PERSONNEL

(Data as of 1968)

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CHAPTER THREE

NASA PERSONNEL

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CHAPTER THREE

NASA PERSONNEL

NASA's predecessor agency, the National Advisory Committee for Aeronautics, employed about 8000 persons when it was disestablished on September 30, 1958. On October 1, 1958, these 8000 persons became employees of the National Aeronautics and Space Administration. NACA's annual budget at the time was about $100 million. In 1967 NASA's employment figure peaked at about 36 000, an increase of 450 percent. NASA's annual expenditures exceeded $5 billion, an increase of 5000 percent over the figures for NACA.

This almost 10-to-1 disparity in the increase in money compared to that in civil servants is a good indicator that NACA carried out most of its activities in its own installations with its own personnel (i.e., in-house), whereas only about 10 percent of NASA's activity is performed in-house, the major share of it being carried out by contractors and thus done out-of-house.

This in-house and out-of-house factor greatly complicates any attempt to depict NASA's manpower patterns. It is relatively easy to tabulate the number of in-house positions and the number of persons filling them. It is much more difficult to find out how many and what kinds of persons were working on NASA's program via contract. Requirements of public law guaranteed that accurate data on in-house personnel be reported. Data on contractor personnel had to await the development of some kind of reporting system. One result of this situation is that the data in this chapter focus primarily on in-house personnel rather than the much larger number of persons "employed" by NASA through its contractors.

The tables that follow can be divided into four groups. Tables 3-1 through 3-7 consist primarily of data in the form of head counts of in-house personnel for the agency as a whole. Tables 3-8 through 3-23 present much of the same data broken out by installation. Tables 3-24 and 3-25 focus on the number of positions provided for in NASA's annual budget and a distribution of these positions by major program area. Finally Tables 3-26 and 3-27 give some overall dimensions to the number of contractor employees.

The principal cautionary point to be kept in mind when using the data that follow is that people are not as neatly categorized as the tables might imply. The terms used must be defined and the categories explained. A word must also be said about the principal sources of the data presented.

Sources of Data

1. NASA Quarterly Personnel Statistical Report (QPSR). The report was discontinued December 31, 1966. Primarily a head count of NASA employees with information for each reporting installation on such things as kinds of appointment, occupational code groupings, grades, accessions, and separations.

2. NASA Personnel Management Information System (PMIS). A computerized successor to the Quarterly Personnel Statistical Report. Generated data in a variety of formats and included a larger number of variables than the QPSR.

3. NASA Manpower Information Digest. Issued every January since 1965. Summarized the data available on NASA's out-of-house or contractor manpower. Prepared by the Management Information Systems Division of NASA Headquarters.

4. The Resources Analysis Division of NASA Headquarters supplied data on the distribution of personnel positions by major program area. The Manpower Utilization Report prepared by the Financial Management Division of NASA Headquarters presented data on man-months of effort and related obligations, but at a level of detail beyond the scope of this chapter.

Definition of Terms

Many of the terms used in the tables of this chapter are defined in NASA Management Instruction 3291, Subject: Personnel Definitions and Reporting Requirements. All of the quotations that follow are from this Management Instruction.

1. *Permanent Employees.* ". . .all employees whose appointments are not time limited or . . . are for a period of more than one year. . . ."

2. *Temporary Employees.* These are called "Other Than Permanent" in the currently used Personnel Management Information System and include "employees whose appointments are specifically limited to definite periods of one year or less. . ." and others who are included in this category by definition (such as CO-OP [Cooperative; alternating work and study] students and intermittent employees).

Note: Tables 3-1 through 3-23 use two different sources of data (QPSR through December 31, 1966, and PMIS subsequently) with slightly varying definitions of Permanent Employees and Temporary (QPSR) or Other Than Permanent (PMIS) Employees. This difference must be explained even though the numbers are relatively small. QPST included TAPER's (Temporary Appointments Pending Establishment of Register) in Temporary whereas PMIS includes them in Permanent. CO-OP Students are Other Than Permanent in the PMIS system but in the QPSR were distributed among Permanent and Temporary depending on each student's tenure or type of appointment. Apprentices are Permanent in the PMIS system but handled the same as CO-OP Students in the QPSR.

3. *Paid Employees.* Permanent Employees and Temporary (i.e., Other Than Permanent) Employees Combined. Specifically excluded from this

category are military personnel detailed to NASA regardless of any reimbursement.

4. *Military Detailees.* Military personnel detailed to NASA. (See definition 3 above.)

5. *Excepted Employees.* Civil Servants who fill high-level permanent positions created under provisions of Section 203(b) of the Space Act of 1958. (P.L. 313 and Executive Pay Act employees are included under this heading for the purposes of this chapter.)

6. *Contractor Employees.* Persons employed under NASA contracts and thus performing work for NASA without being NASA employees.

7. *Grade.* A civil service categorization scheme to differentiate levels of pay, duties, responsibilities, and so forth. Salaries shown in Table 3-4 are those of the General Schedule. Excepted positions are paid in the range from GS-16 to GS-18 and above. Wage Board pay is locally rather than nationally set.

8. *Occupational Code Groups.* The definitions that follow are verbatim quotations from NASA Management Instruction 3291 mentioned above. The tables in this chapter give a subtotal from the 200, 700, and 900 code groups. This subtotal represents the number of professional scientific and technological personnel members employed by NASA. As of June 30, 1961, several adjustments were made in the terminology for the 700 code and extensive conversions were made from the 200 code to the 700 code. Table 3-22 combines the 500 code and the 600 code because they were combined in the 500 code before December 31, 1960. Thus the combination in Table 3-22 is one of convenience and not meant to imply any substantive comparability between the codes. Code 600 is made up of professionals; code 500 is not.

100–Trades and Labor Positions: "Includes trade, craft and general laboring positions (non-supervisory, leader and supervisory), compensated on the basis of prevailing locality wage rates."

200–Support Engineering and Related Positions: "Includes professional physical science, engineering, and mathematician positions in work situations not identified with aerospace technology."

300–Technical Support Positions: "Includes scientific and engineering aid, technician, drafting, photography, illustrating, salaried shop superintendents, quality assurance specialists, production planning and inspecting positions."

500–Clerical and Non-Professional Administrative Positions: "Includes secretarial, specialized and general clerical, and administrative specialist positions, the qualification requirements for which are clerical training and experience or specialized non-professional experience in supply, fiscal, procurement and similar or related activities."

600–Professional Administrative Positions: "Includes professional management positions in research and development administration in such activities as financial management, contracting, personnel, security, administration, law, public affairs and the like for which a college degree or the equivalent, and specialized training and experience are required."

700–AST Scientific and Engineering Positions: "Includes professional scientific and engineering positions requiring Aero-Space Technology (AST) qualifications. Includes professional positions engaged in aerospace research, development, operations, and related work including the development and operation of specialized facilities and supporting equipment."

900–Life Science Positions: "Includes life science professional positions not requiring AST qualifications. Includes medical officers and other positions performing professional work in psychology, the biological sciences and professions which support the science of medicine such as nursing and medical technology."

Organizational Nomenclature

Tables 3-8 through 3-23 list NASA Installations as they existed in 1968. In the 10 years covered by the tables new installations were established, existing ones abolished or consolidated, and many name changes made. Chapter Six of this volume describes what took place in considerable detail and only minimal information is presented here. The transfers that took place were mostly on paper rather than the physical moving of employees.

1. *Headquarters.* From time to time figures for Headquarters include small ad hoc and emerging units (such as the North Eastern Office before March 31, 1963).

2. *NASA Pasadena Office.* The NASA Resident Office-JPL was established March 3, 1964, and consolidated with two other offices to form NASA Pasadena Office August 8, 1966.

3. *Western Support Office.* The former Western Coordination Office was renamed Western Operations Office in August 1959. Transformed into Western Support Office June 15, 1966. Disestablished March 1, 1968. Until late 1959, personnel figures were included with the totals for the Flight Research Center.

4. *Other Western Offices.* The Pacific Launch Operations Office had an independent reporting status between March 1962 and October 1965. NASA Office-Downey had complex connections with other NASA installations. Its somewhat independent status for reporting purposes stretched from mid-1966 to its disestablishment April 9, 1967, and data for it appear only in the December 31, 1966, column of tables 3-8 through 3-23.

5. *Langley Research Center.* Dates from 1917. In November 1959 the 490-member Space Task Group was transferred to the jurisdiction of the Goddard Space Flight Center. In January 1960, 225 persons were transferred to the jurisdiction of Wallops Station.

6. *Ames Research Center.* Dates from 1941.

7. *Lewis Research Center.* Dates from 1942.

8. *Flight Research Center.* Dates from 1947. Name changed from High Speed Flight Station on September 27, 1959.

9. *Electronics Research Center.* Established on September 1, 1964. Data before that date are for NASA's North Eastern Office (NEO).

10. *AEC-NASA Space Nuclear Propulsion Office.* Established as AEC-NASA Nuclear Propulsion Office August 31, 1960, with a further agreement February 1, 1966, and renamed AEC-NASA Space Nuclear Propulsion Office July 28, 1961.

11. *Goddard Space Flight Center.* Dates from NASA's origin. On November 30, 1958, 148 persons were transferred from NRL/Vanguard of

the Navy Department. In November 1959 the 490-member Space Task Group was transferred from the Langley Research Center and in January 1961 the Space Task Group, numbering about 660 persons, became independent–to become the Manned Spacecraft Center in August 1961 (moving to Houston in 1962).

12. *Wallops Station.* Dates from 1945. Part of the Langley Research Center until January 1960 when independent status was attained and 225 persons transferred to it from Langley.

13. *Marshall Space Flight Center.* NASA Huntsville Facility established March 14, 1959, and named George C. Marshall Space Flight Center March 15. Mass transfer of 4256 persons from the Army to NASA occurred July 10, 1960. Transfers to the Launch Operations Center occurred in July 1962 (338 persons) and May 1963 (276 persons).

14. *Manned Spacecraft Center.* The Space Task Group was given independent status in January 1961 and about 660 persons were transferred to it from Goddard. The Manned Spacecraft Center was funded in August 1961. The physical move from Langley to Houston took place in mid-1962.

15. *John F. Kennedy Space Center, NASA.* The Launch Operations Center achieved independent status in March 1962 and 338 persons transferred to it from Marshall. In May 1963, 276 more followed. It was named for the late President Kennedy in November 1963.

16. *Jet Propulsion Laboratory.* Owned by NASA but operated and staffed by the California Institute of Technology via contracts. Transferred to NASA from the Army in December 1958.

Tables

In the tables which follow, Tables 3-1 through 3-23 are based on data supplied by the NASA Personnel Division unless otherwise indicated. Through December 31, 1966, the data derive from the NASA Quarterly Personnel Statistical Report (QPSR). Subsequent data derive from the NASA Personnel Management Information System, which superseded the Quarterly Personnel Statistical Report.

Table 3-1. Civilian and Military In-house Personnel
(number on board)

Category of Employee[a]	1958 9/30	1958 12/31	1959 6/30	1959 12/31	1960 6/30	1960 12/31	1961 6/30	1961 12/31	1962 6/30	1962 12/31
Permanent employees (Civil Service)	7 867	8 326	9 123	9 496	10 085	15 682	16 536	18 454	22 052	24 758
Temporary employees (Civil Service)	99	94	112	71	147	360	935	533	1 634	909
Total paid employees (Civil Service)	7 966	8 420	9 235	9 567	10 232	16 042	17 471	18 987	23 686	25 667
Military detailees	74	66	58	67	52	77	88	117	138	161
Total in-house manpower	8 040	8 486	9 293	9 634	10 284	16 119	17 559	19 104	23 824	25 828
Net increase, previous six months	---	446	807	341	650	5 835	1 440	1 545	4 720	2 004
Percentage increase	---	5.5%	9.5%	3.7%	6.7%	56.7%	8.9%	8.8%	24.7%	8.4%
Net increase, permanent only	---	459	797	373	589	5 597	854	1 918	3 598	2 706
Percentage increase, permanent only	---	5.8%	9.6%	4.1%	6.2%	55.5%	5.4%	11.6%	19.5%	12.3%

Table 3-1. Civilian and Military In-house Personnel (Continued)
(number on board)

Category of Employee[a]	1963 6/30	1963 12/31	1964 6/30	1964 12/31	1965 6/30	1965 12/31	1966 6/30	1966 12/31	1967 6/30	1967 12/31	1968 6/30
Permanent employees (Civil Service)	28 358	29 482	31 285	32 335	32 697	32 663	33 538	33 722	33 677	33 172	32 342
Temporary employees (Civil Service)	1 576	587	1 214	773	1 352	692	2 170	644	2 183	767	2 299
Total paid employees (Civil Service)	29 934	30 069	32 499	33 108	34 049	33 355	35 708	34 366	35 860	33 939	34 641
Military detailees	216	239	250	249	222	280	305	323	309	318	317
Total in-house manpower	30 150	30 308	32 749	33 357	34 271	33 635	36 013	34 689	36 169	34 257	34 958
Net increase, permanent only	4 322	158	2 441	608	914	-636	2 378	-1 324	1 480	-1 912	701
Percentage increase, permanent only	16.7%	0.5%	8.1%	1.9%	2.7%	-1.9%	7.1%	-3.7%	4.3%	-5.3%	2.0%
Net increase, permanent only	3 600	1 124	1 803	1 050	362	-34	875	184	-45	-505	-830
Percentage increase, permanent only	14.5%	4.0%	6.1%	3.4%	1.1%	-0.1%	2.7%	0.5%	-0.1%	-1.5%	-2.5%

[a] See introduction to this chapter for a definition of terms.

Table 3-2. Accessions and Separations of Paid Employees
(activity for six-month periods)

Activity and Category of Employee[a]	1958[b]		1959		1960		1961		1962		1963	
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31
Accessions[c]												
Permanent employees	375	936	1179	798	995	2066	1568	2616	4428	4006	4700	3002
Temporary employees	84	29	164	64	198	507	1059	543	1740	1058	1865	722
Total	459	965	1343	862	1193	2573	2627	3159	6168	5064	6565	3724
Separations												
Permanent employees	226	460	390	420	422	838	783	1015	1138	1693	1548	2161
Temporary employees	85	26	129	94	97	174	360	639	399	1401	723	1404
Total	311	486	519	514	519	1012	1143	1654	1507	3094	2271	3565
Net accessions, total	148	479	824	348	674	1561	1484	1505	4661	1970	4294	159
Percentage increase[d]	--	6.0%	9.8%	3.8%	7.0%	15.3%	9.3%	8.6%	24.5%	8.3%	16.7%	0.5%
Net accessions, permanent	149	476	789	378	573	1228	785	1601	3320	2313	3152	841
Percentage increase, permanent[d]	--	6.1%	9.5%	4.1%	6.0%	12.2%	5.0%	9.7%	18.0%	10.5%	12.7%	3.0%

Table 3-2. Accessions and Separations of Paid Employees (Continued)
(activity for six-month periods)

Activity and Category of Employee[a]	1964		1965		1966		1967		1968
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Accessions[c]									
Permanent employees	3314	2885	2129	2200	3161	2316	2426	914	1034
Temporary employees	1410	1162	1195	1722	2111	708	1819	596	1963
Total	4724	4047	3324	3922	5262	3024	4245	1510	2997
Separations									
Permanent employees	1784	2134	1945	2471	2420	2329	2268	1449	2009
Temporary employees	502	1329	400	2157	504	1799	487	1802	465
Total	2286	3463	2345	4628	2924	4128	2755	3251	2474
Net accessions, total	2438	584	979	-706	2338	-1104	1490	-1741	523
Percentage increase[d]	8.1%	1.8%	3.0%	-2.1%	7.0%	-3.1%	4.3%	-4.9%	1.5%
Net accessions, permanent	1530	751	184	-271	741	-13	158	-535	-975
Percentage increase, permanent[d]	5.2%	2.4%	0.6%	-0.8%	2.3%	-0.04%	0.5%	-1.6%	-2.9%

[a] See introduction to this chapter for a definition of terms.

[b] For three-month periods ending on date indicated. These are the last three months of NACA and the first three months of NASA.

[c] Excludes certain transferees such as the July 1, 1960, mass transfer at Huntsville, Alabama.

[d] Percentage calculated by dividing the net accessions or separations for a six-month period by the number of paid employees at the beginning of that six-month period.

Table 3-3. Paid Employees by NASA Occupation Code Groups
(number on board and percentage of NASA total)

NASA Code Occupational Groups[a]	1958		1959		1960		1961		1962	
	9/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31
200 (General scientists and engineers)	604 7.6%	660 7.8%	728 7.9%	764 8.0%	783 7.7%	1 347 8.4%	312 1.8%	231 1.2%	294 1.2%	375 1.5%
700 (Aerospace scientists and engineers)	2044 25.7%	2158 25.6%	2466 26.7%	2603 27.2%	2 726 26.6%	3 854 24.0%	5 453 31.2%	6 087 32.1%	7 867 33.2%	8 865 34.5%
900 (Primarily life sciences)	---	---	---	---	---	---	---	---	---	---
200, 700, 900 subtotal	2648 33.3%	2818 33.5%	3194 34.6%	3367 35.2%	3 509 34.3%	5 201 32.4%	5 765 33.0%	6 318 33.3%	8 161 34.5%	9 240 36.0%
300 (Technical support)	714 9.0%	785 9.3%	844 9.1%	853 8.9%	922 9.0%	1 791 11.2%	2 295 13.1%	2 272 12.0%	3 390 14.3%	3 068 12.0%
600 (Professional administrative)	---	---	---	---	---	792 4.9%	943 5.4%	1 317 6.9%	1 834 7.7%	2 303 9.0%
500 (Primarily clerical)	1045 13.1%	1186 14.1%	1445 15.6%	1602 18.8%	2 031 19.8%	2 336 14.6%	2 635 15.1%	2 997 15.8%	3 939 16.6%	4 474 17.4%
100 (Trades and labor)	3558 44.7%	3631 43.1%	3752 40.6%	3745 39.1%	3 770 36.8%	5 922 36.9%	5 833 33.4%	6 083 32.0%	6 362 26.9%	6 578 25.6%
Total paid employees	7966	8420	9235	9567	10 232	16 042	17 471	18 987	23 686	25 667

Table 3-3. Paid Employees by NASA Occupation Code Groups (Continued)
(number on board and percentage of NASA total)

	1963		1964		1965		1966		1967		1968
NASA Code Occupational Groups[a]	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
200 (General scientists and engineers)	405 1.4%	429 1.4%	420 1.3%	427 1.3%	420 1.2%	408 1.2%	422 1.2%	385 1.1%	387 1.1%	361 1.1%	332 1.0%
700 (Aerospace scientists and engineers)	10 560 35.3%	11 007 36.6%	11 966 36.8%	12 494 37.7%	12 793 37.6%	12 726 38.2%	13 580 38.0%	13 327 38.8%	14 018 39.1%	13 662 40.3%	13 842 40.0%
900 (Primarily life sciences)	13 0.04%	27 0.1%	41 0.1%	46 0.1%	52 0.2%	54 0.2%	58 0.2%	48 0.1%	50 0.1%	44 0.1%	47 0.1%
200, 700, 900 subtotal	10 978 36.7%	11 463 38.1%	12 427 38.2%	12 967 39.2%	13 265 38.9%	13 188 39.5%	14 060 39.4%	13 760 40.0%	14 455 40.3%	14 067 41.4%	14 221 41.1%
300 (Technical support)	4 079 13.6%	3 637 12.1%	3 947 12.1%	3 922 11.8%	4 144 12.2%	4 163 12.5%	4 852 13.6%	4 610 13.4%	4 859 13.5%	4 680 13.8%	4 977 14.4%
600 (Professional administrative)	2 800 9.4%	3 064 10.2%	3 422 10.5%	3 632 11.0%	3 762 11.0%	3 827 11.5%	4 188 11.7%	4 417 12.9%	4 644 13.0%	4 629 13.6%	4 477 12.9%
500 (Primarily clerical)	5 292 17.7%	5 133 17.1%	5 850 18.0%	5 816 17.6%	5 972 17.5%	5 913 17.7%	6 492 18.2%	6 073 17.7%	6 251 17.4%	5 499 16.2%	5 632 16.3%
100 (Trades and labor)	6 785 22.7%	6 772 22.5%	6 853 21.1%	6 771 20.5%	6 906 20.3%	6 264 18.8%	6 116 17.1%	5 506 16.0%	5 651 15.8%	5 064 14.9%	5 334 15.4%
Total paid employees	29 934	30 069	32 499	33 108	34 049	33 355	35 708	34 366	35 860	33 939	34 641

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[a] See introduction to this chapter for a full description of occupational code groups. Note especially the initiation of the 600 category and conversion of the 200 category.

Table 3-4. Paid Employees by General Schedule Grade
(number on board)

Grade and 6/30/68 General Schedule Salary Rates	1958		1959		1960		1961		1962	
	9/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31
GS-18 ($27 055)	0	0	0	0	0	1	1	1	1	0
GS-16 ($20 982-$26 574)	26	3	0	0	0	0	4	4	4	4
GS-15 ($18 404-$23 921)	242	209	210	262	323	537	614	769	1 001	1 186
GS-14 ($15 841-$20 593)	274	313	374	439	508	857	998	1 146	1 495	1 814
GS-13 ($13 507-$17 557)	557	591	646	668	755	1 209	1 330	1 542	1 992	2 428
GS-12 ($11 461-$14 899)	557	599	660	689	751	1 223	1 381	1 636	2 064	2 516
GS-11 ($ 9 657-$12 555)	481	543	602	683	782	1 442	1 555	1 783	2 001	2 262
GS-10 ($ 8 821-$11 467)	15	16	18	18	14	17	13	13	14	18
GS-9 ($ 8 054-$10 475)	543	582	684	762	812	1 151	1 145	1 133	1 486	1 766
GS-8 ($ 7 384-$ 9 598)	17	21	21	20	24	25	24	35	30	28
GS-7 ($ 6 734-$ 8 759)	343	384	625	598	563	724	987	1 066	1 706	1 623
GS-6 ($ 6 137-$ 7 982)	132	157	165	167	198	283	318	370	438	498
GS-5 ($ 5 565-$ 7 239)	498	492	457	480	564	918	973	1 063	1 328	1 509
GS-4 ($ 4 995-$ 6 439)	381	426	461	459	483	736	926	1 018	1 433	1 529
GS-3 ($ 4 466-$ 5 807)	264	262	286	291	335	544	793	813	1 509	1 266
GS-2 ($ 4 108-$ 5 341)	52	60	71	76	119	165	278	164	371	172
GS-1 ($ 3 776-$ 4 910)	0	0	1	0	0	0	1	5	6	5
Wage Board	3558	3631	3752	3745	3 770	5 922	5 833	6 083	6 362	6 578
Excepted, WAE's,[a] others	26	131	202	210	231	288	297	343	445	465
Total paid employees	7966	8420	9235	9567	10 232	16 042	17 471	18 987	23 686	25 667
Percentage of total										
GS 14-18 ($15 841-$27 055)	6.8%	6.2%	6.3%	7.3%	8.1%	8.7%	9.3%	10.1%	10.6%	11.7%
GS 10-13 ($ 8 821-$17 557)	20.2	20.8	20.9	21.5	22.5	24.3	24.5	26.2	25.6	28.1
GS 7-9 ($ 6 734-$10 475)	11.3	11.7	14.4	14.4	13.7	11.8	12.3	11.8	13.6	13.3
GS 4-6 ($ 4 995-$ 7 982)	12.7	12.8	11.7	11.6	12.2	12.1	12.7	12.9	13.5	13.8
GS 1-3 ($ 3 776-$ 5 807)	4.0	3.9	3.9	3.8	4.4	4.4	6.1	5.2	8.0	5.6
Wage Board	44.7	43.1	40.6	39.1	36.8	36.9	33.4	32.0	26.7	25.6
Excepted, WAE's others	0.3	1.6	2.2	2.2	2.3	1.8	1.7	1.8	1.9	1.8

Table 3-4. Paid Employees by General Schedule Grade (Continued)
(number on board)

	1963		1964		1965		1966		1967		1968
Grade and 6/30/68 General Schedule Salary Rates	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
GS-18 ($27 055)	0	0	0	0	0	0	0	0	0	0	0
GS-16 ($20 982-$26 574)	4	4	4	153	250	274	276	303	310	319	314
GS-15 ($18 404-$23 921)	1 360	1 533	1 611	1 532	1 606	1 647	1 757	1 812	1 908	1 947	2 029
GS-14 ($15 841-$20 593)	2 087	2 285	2 464	2 586	2 640	2 762	2 955	3 101	3 298	3 375	3 429
GS-13 ($13 507-$17 557)	2 939	3 232	3 679	3 901	3 984	4 107	4 470	4 658	4 875	5 088	5 130
GS-12 ($11 461-$14 899)	2 964	3 312	3 662	4 002	4 055	4 192	4 265	4 329	4 323	4 290	4 289
GS-11 ($ 9 657-$12 555)	2 654	2 885	3 191	3 532	3 622	3 656	3 665	3 541	3 529	3 423	3 331
GS-10 ($ 8 821-$11 467)	21	21	23	34	57	67	178	205	242	285	320
GS-9 ($ 8 054-$10 475)	2 266	2 374	2 456	2 499	2 467	2 263	2 374	2 254	2 349	2 341	2 354
GS-8 ($ 7 384-$ 9 598)	35	46	50	60	86	90	176	201	199	201	229
GS-7 ($ 6 734-$ 8 759)	1 949	1 610	1 701	1 458	1 576	1 383	2 019	1 639	2 002	1 529	1 494
GS-6 ($ 6 137-$ 7 982)	541	591	671	684	700	705	809	818	820	782	796
GS-5 ($ 5 565-$ 7 239)	1 709	1 779	1 901	1 891	1 926	1 924	2 100	1 990	2 128	2 052	2 043
GS-4 ($ 4 995-$ 6 439)	2 117	1 888	2 119	1 941	1 913	1 819	2 002	1 806	2 024	1 740	1 745
GS-3 ($ 4 466-$ 5 807)	1 749	1 154	1 324	1 290	1 301	1 209	1 309	1 233	1 254	824	882
GS-2 ($ 4 108-$ 5 341)	270	103	291	276	425	479	644	392	442	158	388
GS-1 ($ 3 776-$ 4 910)	0	0	3	12	89	19	19	86	9	52	17
Wage Board	6 785	6 772	6 853	6 771	6 906	6 264	6 116	5 506	5 651	5 064	5 334
Excepted, WAE's , others	484	480	496	486	446	475	493	492	487	469	517
Total paid employees	29 934	30 069	32 499	33 108	34 049	33 355	35 708	34 366	35 860	33 939	34 641
Percentage of total											
GS 14-18 ($15 841-$27 055)	11.5%	12.7%	12.6%	12.9%	13.2%	14.0%	14.0%	15.7%	15.4%	16.6%	16.7%
GS 10-13 ($ 8 821-$17 557)	28.7	31.4	32.5	34.6	34.4	36.0	35.2	37.1	36.2	38.6	37.7
GS 7-9 ($ 6 734-$10 475)	14.2	13.4	12.9	12.1	12.1	11.2	12.8	11.9	12.7	12.0	11.8
GS 4-6 ($ 4 995-$ 7 982)	14.6	14.2	14.4	13.6	13.3	13.3	13.8	13.4	13.9	13.5	13.2
GS 1-3 ($ 3 776-$ 5 807)	6.7	4.2	5.0	4.8	5.3	5.1	5.5	5.0	4.8	3.0	3.7
Wage Board	22.7	22.5	21.1	20.5	20.3	18.8	17.1	16.0	15.8	14.9	15.4
Excepted, WAE's, others	1.6	1.6	1.5	1.5	1.3	1.4	1.4	1.4	1.4	1.4	1.5

[a] WAE's = employees who are paid when actually employed.

Table 3-5. NASA Excepted, P.L. 313, and Executive Pay Act Employees
(positions and numbers on board)

	1958		1959		1960		1961		1962	
Employee Category	9/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31
Authorized[a]										
NASA excepted	260	260	260	260	290	290	290	355	425	425
P.L. 313	0	0	0	0	12	12	12	12	12	12
Executive Pay Act	2	2	2	2	2	2	2	2	2	2
Total authorized	262	262	262	262	304	304	304	369	439	439
On board	26	130	195	204	221	270	284	301	364	397
Accessions (six-month period)	1	25	10	12	14	15	8	22	45	34
Separations (six-month period)	0	0	1	5	6	7	10	7	10	11
Net transfers[b]	0	79	56	2	9	41	16	2	28	10
Net increase	1	104	65	9	17	49	14	17	63	33

Table 3-5. NASA Excepted, P.L. 313, and Executive Pay Act Employees (Continued)
(positions and numbers on board)

Employee Category	1963		1964		1965		1966		1967		1968
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Authorized[a]											
NASA excepted	425	425	425	425	425	425	425	425	425	425	425
P.L. 313	12	12	12	12	12	12	12	12	12	12	12
Executive Pay Act	2	2	2	9	9	9	9	9	9	9	9
Total authorized	439	439	439	446	446	446	446	446	446	446	446
On board	411	407	415	420	353	355	355	371	368	395	405
Accessions (six-month period)	17	15	22	33	21	22	15	25	29	43	0
Separations (six-month period)	13	28	14	13	7	19	6	15	30	17	0
Net transfers[b]	10	9	0	-15	-81	-1	-9	6	4	1	0
Net increase	14	-4	8	5	-67	2	0	16	-3	27	10

[a] For further information on these positions see Rosholt, *An Administrative History of NASA*, pp. 56-8, 140-1, 268.

[b] An artificial figure compiled by subtracting separations from accessions and then subtracting that difference from the net increase figure.

See Table 3-4 for data on GS-16.

Table 3-6. Military Detailees, Selected Data
(number on duty)

Category of Data	1958 9/30	1958 12/31	1959 6/30	1959 12/31	1960 6/30	1960 12/31	1961 6/30	1961 12/31	1962 6/30	1962 12/31
Total on duty	74	66	58	67	52	77	88	117	138	161
Accessions, previous six months	10[a]	9[a]	11	8	4	16	7	36	46	66
Separations, previous six months	16[a]	17[a]	18	15	20	3	1	10	23	50
Net increase	---	-8[a]	-8	9	-15	25	11	29	21	23
Occupation groupings[b]										
200	9	9	5	2	1	1	1	6	9	0
700	65	57	53	65	51	76	84	103	124	155
900										
Subtotal	74	66	58	67	52	77	85	109	133	155
Percentage of total	100%	100%	100%	100%	100%	100%	96.6%	93.2%	96.4%	96.3%
300	0	0	0	0	0	0	0	1	1	1
600	---	---	---	---	---	---	2	5	4	5
500	0	0	0	0	0	0	1	2	0	0
Total	74	66	58	67	52	77	88	117	138	161
Number per 10 000 paid civilians	93	78	63	70	51	48	50	62	58	63

Table 3-6. Military Detailees, Selected Data (Continued)
(number on duty)

Category of Data	1963		1964		1965		1966		1967		1968
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Total on duty	216	239	250	249	222	280	305	323	309	318	317
Accessions, previous six months	51	62	26	65	22	111	72	38	28	NA	NA
Separations, previous six months	15	26	30	59	53	49	41	25	34	NA	NA
Net increase[a]	55	23	11	-1	-27	58	25	18	-14	9	-1
Occupation groupings[b]											
200	0	1	1	1	0	0	0	0	0	0	0
700	195	212	221	217	196	251	276	287	271	287	291
900	7	10	11	10	7	6	6	12	11	9	11
Subtotal	202	223	233	228	203	257	282	299	282	296	302
Percentage of total	93.5%	93.3%	93.2%	91.6%	91.4%	91.8%	92.5%	92.6%	91.3%	93.1%	95.3%
300	3	2	2	4	3	9	8	11	11	10	5
600	11	14	12	16	15	13	14	11	15	11	9
500	0	0	3	1	1	1	1	2	1	1	1
Total	216	239	250	249	222	280	305	323	309	318	317
Number per 10 000 paid civilians	72	79	77	75	65	84	85	94	86	94	92

[a] For previous three months.

[b] See Table 3-3.

NA = Not available.

Table 3-7. Temporary Employees, Selected Data
(number on board)

Category of Data	1958		1959		1960		1961		1962	
	9/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31
Total on board	99	94	112	71	147	360	935	533	1634	909
Accessions, previous six months	174[a]	29[a]	164	64	198	507	1059	543	1740	1058
Separations, previous six months	138[a]	26[a]	129	94	97	174	360	639	399	1401
Net increase	----	-5[a]	18	-41	76	213	575	-402	1101	-725
Occupation groupings[b]										
200	1	2	2	1	2	11	10	7	3	6
700	----	2	14	8	14	26	86	72	176	88
900	----	----	----	----	----	----	----	----	----	----
Subtotal	1	4	16	9	16	37	96	79	179	94
Percentage of total	1.0%	4.3%	14.3%	12.7%	10.9%	10.3%	10.3%	14.8%	11.0%	10.3%
300	2	3	6	4	9	48	345	115	746	251
600	----	----	----	----	----	16	34	41	79	98
500	12	16	25	24	93	133	307	180	450	360
100	84	71	65	34	29	126	153	118	180	106
Total	99	94	112	71	147	360	935	533	1634	909

Table 3-7. Temporary Employees, Selected Data (Continued)
(number on board)

Category of Data	1963		1964		1965		1966		1967		1968
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Total on board	1576	587	1214	773	1352	692	2170	644	2183	767	2299
Accessions, previous six months	1865	722	1410	1162	1195	1722	2111	708	1819	NA	NA
Separations, previous six months	723	1404	502	1329	400	2157	504	1799	487	NA	NA
Net increase	667	-989	627	-441	579	-660	1478	-1526	1539	-1416	1532
Occupation groupings[b]											
200	4	1	6	3	6	6	19	2	9	3	4
700	276	69	167	78	132	115	471	118	481	75	362
900	3	1	5	6	12	15	14	3	9	3	4
Subtotal	283	71	178	87	150	136	504	123	499	81	370
Percentage of total	18.0%	12.1%	14.7%	11.3%	11.1%	19.7%	23.2%	19.1%	22.9%	10.6%	16.1%
300	571	146	300	180	265	144	423	125	625	411	629
600	94	60	62	42	45	30	72	47	126	25	88
500	513	207	528	344	447	294	621	205	467	112	396
100	115	103	146	120	445	88	550	144	466	138	816
Total	1576	587	1214	773	1352	692	2170	644	2183	767	2299

[a] For previous three months.
[b] See Table 3-3.

NA = Not available.

Table 3-8. Paid Employees by NASA Installation
(number on board)

Installation[a]	1958		1959		1960		1961		1962	
	9/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31
Headquarters	180	274	429	484	585	662	748	960	1 477	1 693
NASA Pasadena Office	---	---	---	---	---	---	---	---	---	---
Western Support Office[b]	---	---	---	---	37	50	60	84	136	247
Other Western offices[c]	---	---	---	---	---	---	---	---	---	14
Subtotal A[d]	180	274	429	484	622	712	808	1 044	1 613	1 954
Langley Research Center	3368	3501	3795	3456	3 191	3 208	3 338	3 460	3 894	4 007
Ames Research Center	1413	1427	1464	1429	1 421	1 418	1 462	1 529	1 658	1 825
Lewis Research Center	2713	2696	2809	2749	2 722	2 743	2 773	3 036	3 800	4 118
Flight Research Center	292	306	340	332	408	416	447	494	538	568
Electronics Research Center	---	---	---	---	---	---	---	---	---	---
AEC-NASA Space Nuclear Propulsion Office	---	---	---	---	---	---	---	15	39	67
Subtotal B[d]	7786	7930	8408	7966	7 742	7 785	8 020	8 534	9 929	10 585
Goddard Space Flight Center	---	216	398	1117	1 269	1 881	1 599	1 858	2 755	2 858
Wallops Station	---	---	---	---	229	297	302	371	421	430
Subtotal C[d]	---	216	398	1117	1 498	2 178	1 901	2 229	3 176	3 288
Marshall Space Flight Center	---	---	---	---	370	5 367	5 948	6 034	7 182	6 844
Manned Spacecraft Center	---	---	---	---	---	---	794	1 146	1 786	2 392
Kennedy Space Center	---	---	---	---	---	---	---	---	---	604
Subtotal D[d]	---	---	---	---	370	5 367	6 742	7 180	8 968	9 840
Total paid employees	7966	8420	9235	9567	10 232	16 042	17 471	18 987	23 686	25 667

Table 3-8. Paid Employees by NASA Installation (Continued)
(number on board)

Installation[a]	1963		1964		1965		1966		1967		1968
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Headquarters	2 001	2 017	2 158	2 026	2 135	2 112	2 336	2 274	2 373	2 176	2 310
NASA Pasadena Office	---	---	---	16	19	20	85	87	91	87	79
Western Support Office[b]	308	318	376	370	377	343	294	105	119	103	---
Other Western offices[c]	17	19	22	21	21	---	---	127	---	---	---
Subtotal A[d]	2 326	2 354	2 556	2 433	2 552	2 475	2 715	2 593	2 583	2 366	2 389
Langley Research Center	4 220	4 234	4 330	4 329	4 371	4 263	4 485	4 296	4 405	4 211	4 219
Ames Research Center	2 116	2 166	2 204	2 215	2 270	2 236	2 310	2 232	2 264	2 171	2 197
Lewis Research Center	4 697	4 760	4 859	4 878	4 897	4 834	5 047	4 825	4 956	4 623	4 583
Flight Research Center	616	618	619	622	669	629	662	618	642	607	622
Electronics Research Center	25	30	33	117	250	340	555	619	791	785	950
AEC-NASA Space Nuclear Propulsion Office	96	102	112	111	116	112	115	114	113	117	108
Subtotal B[d]	11 770	11 910	12 157	12 272	12 573	12 414	13 174	12 704	13 171	12 514	12 679
Goddard Space Flight Center	3 487	3 443	3 675	3 640	3 774	3 560	3 958	3 791	3 995	3 752	4 073
Wallops Station	493	502	530	523	554	526	563	538	576	509	565
Subtotal C[d]	3 980	3 945	4 205	4 163	4 328	4 086	4 521	4 329	4 571	4 261	4 638
Marshall Space Flight Center	7 332	7 227	7 679	7 639	7 719	7 503	7 740	7 434	7 602	7 288	6 935
Manned Spacecraft Center	3 345	3 364	4 277	4 721	4 413	4 391	4 889	4 688	5 066	4 728	4 956
Kennedy Space Center	1 181	1 269	1 625	1 880	2 464	2 486	2 669	2 618	2 867	2 782	3 044
Subtotal D[d]	11 858	11 860	13 581	14 240	14 596	14 380	15 298	14 740	15 535	14 798	14 935
Total paid employees	29 934	30 069	32 499	33 108	34 049	33 355	35 708	34 366	35 860	33 939	34 641

[a] See introduction to this chapter for an explanation of nomenclature and reporting problems. See Tables 3-11 and 3-15 for data on the Jet Propulsion Laboratory. See Chapter Six for a separate personnel summary for each installation.

[b] Discontinued as of March 1, 1968.

[c] The 12/31/66 figure is for the "NASA Office-Downey." The earlier figures are all for the Pacific Launch Operations Office.

[d] These subtotals express an organizational grouping of NASA field installations. Subtotal B components are associated with the Office of Advanced Research and Technology; Subtotal C components, and JPL, with the Office of Space Sciences and Applications; and Subtotal D components with the Office of Manned Space Flight. The NASA Pasadena Office and the Pacific Launch Operations Office are often thought of as components of Subtotal C rather than with NASA Headquarters, as shown here. This organizational arrangement dates from 1963.

Table 3-9 Paid Employees by NASA Installation
(percentage of NASA total*)

Installation[a]	1958		1959		1960		1961		1962	
	9/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31
Headquarters	2.3	3.3	4.6	5.1	5.7	4.1	4.3	5.1	6.2	6.6
NASA Pasadena Office	---	---	---	---	---	---	---	---	---	---
Western Support Office[b]	---	---	---	---	0.4	0.3	0.4	0.4	0.6	1.0
Other Western offices[c]	---	---	---	---	---	---	---	---	---	0.1
Subtotal A[d]	2.3	3.3	4.6	5.1	6.1	4.4	4.6	5.5	6.8	7.6
Langley Research Center	42.3	41.6	41.1	36.1	31.2	20.0	19.1	18.2	16.4	15.6
Ames Research Center	17.7	16.9	15.9	14.9	13.9	8.8	8.4	8.1	7.0	7.1
Lewis Research Center	34.1	32.0	30.4	28.7	26.7	17.1	15.9	16.0	16.0	16.0
Flight Research Center	3.7	3.6	3.7	3.5	4.0	2.6	2.6	2.6	2.3	2.2
Electronics Research Center	---	---	---	---	---	---	---	---	---	---
AEC-NASA Space Nuclear Propulsion Office	---	---	---	---	---	---	---	0.1	0.2	0.3
Subtotal B[d]	97.7	94.2	91.0	83.3	75.7	48.5	45.9	44.9	41.9	41.2
Goddard Space Flight Center	---	2.6	4.3	11.7	12.4	11.7	9.2	9.8	11.6	11.1
Wallops Station	---	---	---	---	2.2	1.9	1.7	2.0	1.8	1.7
Subtotal C[d]	---	2.6	4.3	11.7	14.6	13.6	10.9	11.7	13.4	12.8
Marshall Space Flight Center	---	---	---	---	3.6	33.5	34.0	31.8	30.3	26.7
Manned Spacecraft Center	---	---	---	---	---	---	4.5	6.0	7.5	9.3
Kennedy Space Center	---	---	---	---	---	---	---	---	---	2.4
Subtotal D[d]	---	---	---	---	3.6	33.5	38.6	37.8	37.9	38.3
Total paid employees	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 3-9. Paid Employees by NASA Installation (Continued)
(percentage of NASA total*)

Installation[a]	1963		1964		1965		1966		1967		1968
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Headquarters	6.7	6.7	6.6	6.1	6.3	6.3	6.5	6.6	6.6	6.4	6.7
NASA Pasadena Office	---	---	---	*	0.1	0.1	0.2	0.3	0.3	0.3	0.2
Western Support Office[b]	1.0	1.1	1.2	1.1	1.1	1.0	0.8	0.3	0.3	0.3	---
Other Western offices[c]	0.1	0.1	0.1	0.1	0.1	---	---	0.4	---	---	---
Subtotal A[d]	7.8	7.8	7.9	7.3	7.5	7.4	7.6	7.5	7.2	7.0	6.9
Langley Research Center	14.1	14.1	13.3	13.1	12.8	12.7	12.6	12.5	12.3	12.4	12.2
Ames Research Center	7.1	7.2	6.8	6.7	6.7	6.7	6.5	6.5	6.3	6.4	6.3
Lewis Research Center	15.7	15.8	15.0	14.7	14.4	14.5	14.1	14.0	13.8	13.6	13.2
Flight Research Center	2.1	2.1	1.9	1.9	2.0	1.9	1.9	1.8	1.8	1.8	1.8
Electronics Research Center	0.1	0.1	0.1	0.4	0.7	1.0	1.6	1.8	2.2	2.3	2.7
AEC-NASA Space Nuclear Propulsion Office	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Subtotal B[d]	39.3	39.6	37.4	37.1	36.9	37.2	36.9	37.0	36.7	36.9	36.6
Goddard Space Flight Center	11.6	11.5	11.3	11.0	11.1	10.7	11.1	11.0	11.1	11.1	11.8
Wallops Station	1.6	1.7	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.5	1.6
Subtotal C[d]	13.3	13.1	12.9	12.6	12.7	12.3	12.7	12.6	12.7	12.6	13.4
Marshall Space Flight Center	24.5	24.0	23.6	23.1	22.7	22.5	21.7	21.6	21.2	21.5	20.0
Manned Spacecraft Center	11.2	11.2	13.2	14.3	13.0	13.2	13.7	13.6	14.1	13.9	14.3
Kennedy Space Center	3.9	4.2	5.0	5.7	7.2	7.5	7.5	7.6	8.0	8.2	8.8
Subtotal D[d]	39.6	39.4	41.8	43.0	42.9	43.1	42.8	42.9	43.3	43.6	43.1
Total paid employees	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

*Percentages are rounded to nearest tenth of one percent and thus may not add to totals. An asterisk in the column indicates less than 0.05 percent.

[a-d]Notes are identical to those for Table 3-8.

Source: Table 3-8.

Table 3-10. Paid Employees by NASA Installation
(changes in number on board)*

Installation[a]	1958		1959		1960		1961		1962	
	9/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31
Headquarters	---	94	155	55	101	77	86	212	517	216
NASA Pasadena Office	---	---	---	---	---	---	---	---	---	---
Western Support Office[b]	---	---	---	---	37	13	10	24	52	111
Other Western offices[c]	---	---	---	---	---	---	---	---	---	14
Subtotal[d]	---	94	155	55	138	90	96	236	569	341
Langley Research Center	---	133	294	-339	-265	17	130	122	434	113
Ames Research Center	---	14	37	-35	-8	-3	44	67	129	167
Lewis Research Center	---	-17	113	-60	-27	21	30	263	764	318
Flight Research Center	---	14	34	-8	76	8	31	47	44	30
Electronics Research Center	---	---	---	---	---	---	---	---	---	---
AEC-NASA Space Nuclear Propulsion Office	---	---	---	---	---	---	---	15	24	28
Subtotal[d]	---	144	478	-442	-224	43	235	514	1395	656
Goddard Space Flight Center	---	216	182	719	152	612	-282	259	897	103
Wallops Station	---	---	---	---	229	68	5	69	50	9
Subtotal[d]	---	216	182	719	381	680	-277	328	947	112
Marshall Space Flight Center	---	---	---	---	370	4997	581	86	1148	-338
Manned Spacecraft Center	---	---	---	---	---	---	794	352	640	606
Kennedy Space Center	---	---	---	---	---	---	---	---	---	604
Subtotal[d]	---	---	---	---	370	4997	1375	438	1788	872
Total increases (decreases)	---	454	815	332	665	5810	1429	1516	4699	1981

Table 3-10. Paid Employees by NASA Installation (Continued)
(changes in number on board)*

	1963		1964		1965		1966		1967		1968
Installation[a]	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Headquarters	308	16	141	-132	109	-23	224	-62	99	-197	134
NASA Pasadena Office	---	---	---	16	3	1	65	2	4	-4	-8
Western Support Office[b]	61	10	58	-6	7	-34	-49	-189	14	-16	-103
Other Western offices[c]	3	2	3	-1	0	-21	---	127	-127	---	---
Subtotal[d]	372	28	202	-123	119	-77	240	-122	-10	-217	23
Langley Research Center	213	14	96	-1	42	-108	222	-189	109	-194	8
Ames Research Center	291	50	38	11	55	-34	74	-78	32	-93	26
Lewis Research Center	579	63	99	19	19	-63	213	-222	131	-333	-40
Flight Research Center	48	2	1	3	47	-40	33	-44	24	-35	15
Electronics Research Center	25	5	3	84	133	90	215	64	172	-6	165
AEC-NASA Space Nuclear Propulsion Office	29	6	10	-1	5	-4	3	-1	-1	-4	-9
Subtotal[d]	1185	140	247	115	301	-159	760	-470	467	-657	165
Goddard Space Flight Center	629	-44	232	-35	134	-214	398	-167	204	-243	321
Wallops Station	63	9	28	-7	31	-28	37	-25	38	-67	56
Subtotal[d]	692	-35	260	-42	165	-242	435	-192	242	-310	377
Marshall Space Flight Center	488	-105	452	-40	80	-216	237	-306	168	-314	-353
Manned Spacecraft Center	953	19	913	444	-308	-22	498	-201	378	-338	228
Kennedy Space Center	577	88	356	255	584	22	183	-51	249	-85	262
Subtotal[d]	2018	2	1721	659	356	-216	918	-558	795	-737	137
Total increases (decreases)	4267	135	2430	609	941	-694	2353	-1342	1494	-1921	702

*Figures shown are the net increase or decrease in the number of paid employees for the six-month period before the date.

[a-d] Notes are identical to those for Table 3-8.

Source: Table 3-8.

Table 3-11. Permanent Employees by NASA Installation
(number on board)

Installation[a]	1958		1959		1960		1961		1962	
	9/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31
Headquarters	176	267	420	477	561	645	716	922	1 321	1 641
NASA Pasadena Office	——	——	——	——	——	——	——	——	——	——
Western Support Office[b]	——	——	——	——	36	49	57	80	130	241
Other Western offices[c]	——	——	——	——	——	——	——	——	——	12
Subtotal A[d]	176	267	420	477	597	694	773	1 002	1 451	1 894
Langley Research Center	3322	3458	3765	3452	3 189	3 201	3 295	3 441	3 766	3 984
Ames Research Center	1386	1406	1439	1413	1 404	1 397	1 429	1 502	1 631	1 788
Lewis Research Center	2703	2687	2802	2741	2 703	2 723	2 751	3 001	3 721	4 025
Flight Research Center	280	294	312	317	392	401	435	477	517	556
Electronics Research Center	——	——	——	——	——	——	——	——	——	——
AEC-NASA Space Nuclear Propulsion Office	——	——	——	——	——	——	——	15	39	66
Subtotal B[d]	7691	7845	8318	7923	7 688	7 722	7 910	8 436	9 674	10 419
Goddard Space Flight Center	——	214	385	1096	1 252	1 741	1 320	1 711	2 287	2 579
Wallops Station	——	——	——	——	228	277	292	359	383	409
Subtotal C[d]	——	214	385	1096	1 480	2 018	1 612	2 070	2 670	2 988
Marshall Space Flight Center	——	——	——	——	320	5 248	5 521	5 911	6 669	6 658
Manned Spacecraft Center	——	——	——	——	——	——	720	1 035	1 588	2 239
Kennedy Space Center	——	——	——	——	——	——	——	——	——	560
Subtotal D[d]	——	——	——	——	320	5 248	6 241	6 946	8 257	9 457
Total permanent employees, NASA	7867	8326	9123	9496	10 085	15 682	16 536	18 454	22 052	24 758
Jet Propulsion Laboratory[a]	2266	2328	2662	2626	2 743	2 655	2 817	3 091	3 497	3 821

Table 3-11. Permanent Employees by NASA Installation (Continued)
(number on board)

Installation[a]	1963		1964		1965		1966		1967		1968
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Headquarters	1 846	1 952	1 978	1 966	1 998	2 019	2 081	2 152	2 138	2 093	2 077
NASA Pasadena Office	----	----	----	16	18	20	79	87	86	87	76
Western Support Office[b]	301	310	369	355	352	339	268	97	99	95	----
Other Western offices[c]	13	16	17	18	17	----	----	125	----	----	----
Subtotal A[d]	2 160	2 278	2 364	2 355	2 385	2 378	2 428	2 461	2 323	2 275	2 153
Langley Research Center	4 112	4 204	4 255	4 298	4 285	4 237	4 280	4 235	4 227	4 168	4 037
Ames Research Center	1 964	2 110	2 152	2 136	2 175	2 155	2 191	2 189	2 173	2 164	2 084
Lewis Research Center	4 577	4 735	4 805	4 806	4 815	4 778	4 819	4 756	4 704	4 583	4 452
Flight Research Center	613	616	618	620	611	608	609	607	587	582	566
Electronics Research Center	24	29	32	117	238	331	470	570	700	744	794
AEC-NASA Space Nuclear Propulsion Office	94	101	107	110	115	112	114	114	112	115	108
Subtotal B[d]	11 384	11 795	11 969	12 087	12 239	12 221	12 483	12 471	12 503	12 356	12 041
Goddard Space Flight Center	3 030	3 310	3 498	3 531	3 613	3 489	3 718	3 754	3 788	3 702	3 746
Wallops Station	473	483	519	513	520	509	512	506	499	496	497
Subtotal C[d]	3 503	3 793	4 017	4 044	4 133	3 998	4 230	4 260	4 287	4 198	4 243
Marshall Space Flight Center	7 243	7 145	7 467	7 517	7 485	7 409	7 416	7 342	7 153	7 026	6 400
Manned Spacecraft Center	3 059	3 297	4 034	4 605	4 274	4 325	4 548	4 649	4 718	4 606	4 588
Kennedy Space Center	1 009	1 174	1 434	1 727	2 181	2 332	2 433	2 539	2 693	2 711	2 917
Subtotal D[d]	11 311	11 616	12 935	13 849	13 940	14 066	14 397	14 530	14 564	14 343	13 905
Total permanent employees, NASA	28 358	29 482	31 285	32 335	32 697	32 663	33 538	33 722	33 677	33 172	32 342
Jet Propulsion Laboratory[a]	4 004	4 134	4 291	4 268	4 027	4 016	4 069	4 333	4 565	4 377	4 102

[a-d]Notes are identical to those for Table 3-8. See Chapter Six for a separate personnel summary for each installation. JPL data supplied by JPL Personnel Office.

Table 3-12. Temporary Employees by NASA Installation
(number on board)

Installation[a]	1958		1959		1960		1961		1962	
	9/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31
Headquarters	4	7	9	7	24	17	32	38	156	52
NASA Pasadena Office	---	---	---	---	---	---	---	---	---	---
Western Support Office[b]	---	---	---	---	1	1	3	4	6	6
Other Western offices[c]	---	---	---	---	---	---	---	---	---	2
Subtotal A[d]	4	7	9	7	25	18	35	42	162	60
Langley Research Center	46	43	30	4	2	7	43	19	128	23
Ames Research Center	27	21	25	16	17	21	33	27	27	37
Lewis Research Center	10	9	7	8	19	20	22	35	79	93.
Flight Research Center	12	12	28	15	16	15	12	17	21	12
Electronics Research Center	---	---	---	---	---	---	---	---	---	---
AEC-NASA Space Nuclear Propulsion Office	---	---	---	---	---	---	---	0	0	1
Subtotal B[d]	95	85	90	43	54	63	110	98	255	166
Goddard Space Flight Center	---	2	13	21	17	140	279	147	468	279
Wallops Station	---	---	---	---	1	20	10	12	38	21
Subtotal C[d]	---	2	13	21	18	160	289	159	506	300
Marshall Space Flight Center	---	---	---	---	50	119	426	123	513	186
Manned Spacecraft Center	---	---	---	---	---	---	74	111	198	153
Kennedy Space Center	---	---	---	---	---	---	---	---	---	44
Subtotal D[d]	---	---	---	---	50	119	500	234	711	383
Total temporary employees	99	94	112	71	147	360	935	533	1634	909

Table 3-12. Temporary Employees by NASA Installation (Continued)
(number on board)

Installation[a]	1963		1964		1965		1966		1967		1968
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Headquarters	155	65	180	60	137	93	255	122	235	83	233
NASA Pasadena Office	---	---	---	0	1	0	6	0	5	0	3
Western Support Office[b]	7	8	7	15	25	4	26	8	20	8	---
Other Western offices[c]	4	3	5	3	4	---	---	2	---	---	---
Subtotal A[d]	166	76	192	78	167	97	287	132	260	91	236
Langley Research Center	108	30	75	31	86	26	205	61	178	43	182
Ames Research Center	152	56	52	79	95	81	119	43	91	7	113
Lewis Research Center	120	25	54	72	82	56	228	69	252	40	131
Flight Research Center	3	2	1	2	58	21	53	11	55	25	56
Electronics Research Center	1	1	1	0	12	9	85	49	91	41	156
AEC-NASA Space Nuclear Propulsion Office	2	1	5	1	1	0	1	0	1	2	0
Subtotal B[d]	386	115	188	185	334	193	691	233	568	158	638
Goddard Space Flight Center	457	133	177	109	161	71	240	37	207	50	327
Wallops Station	20	19	11	10	34	17	51	32	77	13	68
Subtotal C[d]	477	152	188	119	195	88	291	69	284	63	395
Marshall Space Flight Center	89	82	212	122	234	94	324	92	449	262	535
Manned Spacecraft Center	286	67	243	116	139	66	341	39	348	122	368
Kennedy Space Center	172	95	191	153	283	154	236	79	174	71	127
Subtotal D[d]	547	244	646	391	656	314	901	210	971	455	1030
Total temporary employees	1576	587	1214	773	1352	692	2170	644	2183	767	2299

[a-d] Notes are identical to those for Table 3-8. See Chapter Six for a separate personnel summary for each installation.

Table 3-13. NASA Excepted, P.L. 313, and EPA Employees by NASA Installation
(number on board)

Installation[a]	1958		1959		1960		1961		1962	
	9/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31
Headquarters	9	46	68	72	88	96	100	108	133	156
NASA Pasadena Office	---	---	---	---	---	---	---	---	---	---
Western Support Office[b]	---	---	---	---	1	1	1	1	3	3
Other Western offices[c]	---	---	---	---	---	---	---	---	---	0
Subtotal A[d]	9	46	68	72	89	97	101	109	136	159
Langley Research Center	9	31	46	40	36	37	38	37	40	38
Ames Research Center	0	15	21	21	21	21	22	24	26	25
Lewis Research Center	7	29	33	32	28	27	26	27	32	35
Flight Research Center	1	5	7	7	8	7	7	7	8	7
Electronics Research Center	---	---	---	---	---	---	---	---	---	---
AEC-NASA Space Nuclear Propulsion Office	---	---	---	---	---	---	---	0	2	2
Subtotal B[d]	17	80	107	100	93	92	93	95	108	107
Goddard Space Flight Center	---	4	20	32	35	37	30	32	36	38
Wallops Station	---	---	---	---	1	1	2	2	2	2
Subtotal C[d]	---	4	20	32	36	38	32	34	38	40
Marshall Space Flight Center	---	---	---	---	3	43	48	47	54	55
Manned Spacecraft Center	---	---	---	---	---	---	10	16	28	34
Kennedy Space Center	---	---	---	---	---	---	---	---	---	2
Subtotal D[d]	---	---	---	---	3	43	58	63	82	91
Total excepted employees	26	130	195	204	221	270	284	301	364	397

Table 3-13. NASA Excepted, P.L. 313, and EPA Employees by NASA Installation (Continued)
(number on board)

Installation[a]	1963		1964		1965		1966		1967		1968
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Headquarters	162	154	157	166	147	154	153	160	159	169	177
NASA Pasadena Office	---	---	---	0	0	0	1	1	1	1	1
Western Support Office[b]	3	3	3	3	4	4	3	1	1	1	---
Other Western offices[c]	0	0	0	0	0	---	---	1	---	---	---
Subtotal A[d]	165	157	160	169	151	158	157	163	161	171	178
Langley Research Center	38	36	36	35	28	28	28	28	27	28	26
Ames Research Center	28	28	26	25	19	19	20	21	20	21	21
Lewis Research Center	35	36	35	35	27	26	24	25	25	27	27
Flight Research Center	7	7	6	6	5	5	4	4	6	6	6
Electronics Research Center	2	2	2	5	8	7	7	7	7	7	7
AEC-NASA Space Nuclear Propulsion Office	2	3	3	3	2	2	2	2	2	3	3
Subtotal B[d]	112	112	108	109	89	87	85	87	87	92	90
Goddard Space Flight Center	38	39	40	40	33	29	32	31	32	36	37
Wallops Station	2	1	1	1	1	1	1	2	2	2	2
Subtotal C[d]	40	40	41	41	34	30	33	33	34	38	39
Marshall Space Flight Center	53	54	56	52	40	38	38	39	40	40	40
Manned Spacecraft Center	35	38	36	35	29	29	29	30	28	33	34
Kennedy Space Center	6	6	14	14	10	13	13	19	18	21	24
Subtotal D[d]	94	98	106	101	79	80	80	88	86	94	98
Total excepted employees	411	407	415	420	353	355	355	371	368	395	405

[a-d] Notes are identical to those for Table 3-8. See Chapter Six for a separate personnel summary for each installation.

Table 3-14. NASA Excepted, P.L. 313, and EPA Employees by NASA Installation
(percentage of NASA total[e])

Installation[a]	1958		1959		1960		1961		1962	
	9/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31
Headquarters	34.6	35.4	34.9	35.3	39.8	35.6	35.2	35.9	36.5	39.3
NASA Pasadena Office	---	---	---	---	---	---	---	---	---	---
Western Support Office[b]	---	---	---	---	0.5	0.4	0.4	0.3	0.8	0.8
Other Western offices[c]	---	---	---	---	---	---	---	---	---	0.0
Subtotal A[d]	34.6	35.4	34.9	35.3	40.3	35.9	35.6	36.2	37.4	40.1
Langley Research Center	34.6	23.8	23.6	19.6	16.3	13.7	13.4	12.3	11.0	9.6
Ames Research Center	0	11.5	10.8	10.3	9.5	7.8	7.7	8.0	7.1	6.3
Lewis Research Center	26.9	22.3	16.9	15.7	12.7	10.0	9.2	9.0	8.8	8.8
Flight Research Center	3.8	3.8	3.6	3.4	3.6	2.6	2.5	2.3	2.2	1.8
Electronics Research Center	---	---	---	---	---	---	---	---	---	---
AEC-NASA Space Nuclear Propulsion Office	---	---	---	---	---	---	---	---	0.5	0.5
Subtotal B[d]	65.4	61.5	54.9	49.0	42.1	34.1	32.7	31.6	29.7	26.4
Goddard Space Flight Center	---	3.1	10.3	15.7	15.8	13.7	10.6	10.6	9.9	9.6
Wallops Station	---	---	---	---	0.5	0.4	0.7	0.7	0.5	0.5
Subtotal C[d]	---	3.1	10.3	15.7	16.3	14.1	11.3	11.3	10.4	10.1
Marshall Space Flight Center	---	---	---	---	1.4	15.9	16.9	15.6	14.8	13.9
Manned Spacecraft Center	---	---	---	---	---	---	3.5	5.3	7.7	8.6
Kennedy Space Center	---	---	---	---	---	---	---	---	---	0.5
Subtotal D[d]	---	---	---	---	1.4	15.9	20.4	20.9	22.5	22.9
Total for NASA	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 3-14. NASA Excepted, P.L. 313, and EPA Employees by NASA Installation (Continued)
(percentage of NASA total*)

Installation[a]	1963		1964		1965		1966		1967		1968
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Headquarters	39.4	37.8	37.8	39.5	41.6	43.4	43.1	43.1	43.2	42.8	43.7
NASA Pasadena Office	---	---	---	0.0	0.0	0.0	0.3	0.3	0.3	0.3	0.2
Western Support Office[b]	0.7	0.7	0.7	0.7	1.1	1.1	0.8	0.3	0.3	0.3	---
Other Western offices[c]	0.0	0.0	0.0	0.0	0.0	---	---	0.3	---	---	---
Subtotal A[d]	40.1	38.6	38.6	40.2	42.8	44.5	44.2	43.9	43.8	43.3	44.0
Langley Research Center	9.2	8.8	8.7	8.3	7.9	7.9	7.9	7.5	7.3	7.1	6.4
Ames Research Center	6.8	6.9	6.3	6.0	5.4	5.4	5.6	5.7	5.4	5.3	5.2
Lewis Research Center	8.5	8.8	8.4	8.3	7.6	7.3	6.8	6.7	6.8	6.8	6.7
Flight Research Center	1.7	1.7	1.4	1.4	1.4	1.4	1.1	1.1	1.6	1.5	1.5
Electronics Research Center	0.5	0.5	0.5	1.2	2.3	2.0	2.0	1.9	1.9	1.8	1.7
AEC-NASA Space Nuclear Propulsion Office	0.5	0.7	0.7	0.7	0.6	0.6	0.6	0.5	0.5	0.8	0.7
Subtotal B[d]	27.3	27.5	26.0	26.0	25.2	24.5	23.9	23.5	23.6	23.3	22.2
Goddard Space Flight Center	9.2	9.6	9.6	9.5	9.3	8.2	9.0	8.4	8.7	9.1	9.1
Wallops Station	0.5	0.2	0.2	0.2	0.3	0.3	0.3	0.5	0.5	0.5	0.5
Subtotal C[d]	9.7	9.8	9.9	9.8	9.6	8.5	9.3	8.9	9.2	9.6	9.6
Marshall Space Flight Center	12.9	13.3	13.5	12.4	11.3	10.7	10.7	10.5	10.9	10.1	9.9
Manned Spacecraft Center	8.5	9.3	8.7	8.3	8.2	8.2	8.1	8.1	7.6	8.4	8.4
Kennedy Space Center	1.5	1.5	3.4	3.3	2.8	3.7	3.6	5.1	4.9	5.3	5.9
Subtotal D[d]	22.9	24.1	25.5	24.0	22.4	22.5	22.5	23.7	23.4	23.8	24.2
Total for NASA	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

*Percentages are rounded to nearest tenth of one percent and thus may not add to totals.
[a-d]Notes are identical to those for Table 3-8.

Source: Table 3-13.

Table 3-15. Military Detailees by NASA Installation
(number on duty)

Installation[a]	1958		1959		1960		1961		1962	
	9/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31
Headquarters	0	0	0	0	0	11	13	21	26	25
NASA Pasadena Office	---	---	---	---	---	---	---	---	---	---
Western Support Office[b]	---	---	---	---	0	0	0	0	0	0
Other Western offices[c]	---	---	---	---	---	---	---	---	---	0
Subtotal A[d]	0	0	0	0	0	11	13	21	26	25
Langley Research Center	20	13	11	13	11	12	10	16	19	24
Ames Research Center	21	19	14	19	16	16	16	19	16	12
Lewis Research Center	25	28	30	23	12	11	12	12	15	29
Flight Research Center	8	6	3	2	3	3	4	3	2	3
Electronics Research Center	---	---	---	---	---	---	---	---	---	---
AEC-NASA Space Nuclear Propulsion Office	---	---	---	---	---	---	---	0	1	1
Subtotal B[d]	74	66	58	57	42	42	42	50	53	69
Goddard Space Flight Center	---	0	0	10	10	11	3	6	9	8
Wallops Station	---	---	---	---	0	2	3	3	4	4
Subtotal C[d]	---	0	0	10	10	13	6	9	13	12
Marshall Space Flight Center	---	---	---	---	0	11	16	20	25	22
Manned Spacecraft Center	---	---	---	---	---	---	11	17	21	23
Kennedy Space Center	---	---	---	---	---	---	---	---	---	10
Subtotal D[d]	---	---	---	---	0	11	27	37	46	55
Total military detailees, NASA	74	66	58	67	52	77	88	117	138	161
Jet Propulsion Laboratory	0	0	0	0	0	9	10	13	17	23

Table 3-15. Military Detailees by NASA Installation (Continued)
(number on duty)

Installation[a]	1963		1964		1965		1966		1967		1968
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Headquarters	32	34	33	40	40	37	33	32	30	24	23
NASA Pasadena Office	---	---	0	0	0	0	0	0	0	18	14
Western Support Office[b]	0	0	0	0	0	0	0	0	0	0	---
Other Western offices[c]	0	0	0	0	0	---	---	0	---	---	---
Subtotal A[d]	32	34	33	40	40	37	33	32	30	42	37
Langley Research Center	31	32	31	21	16	14	8	6	5	5	5
Ames Research Center	10	14	13	11	11	10	9	10	9	10	13
Lewis Research Center	39	42	40	31	23	18	9	11	13	16	20
Flight Research Center	3	3	5	5	4	4	3	5	7	10	10
Electronics Research Center	0	0	0	3	3	1	3	3	0	5	6
AEC-NASA Space Nuclear Propulsion Office	0	0	0	0	0	0	0	0	0	0	0
Subtotal B[d]	83	89	89	71	57	47	32	35	34	46	54
Goddard Space Flight Center	14	15	14	11	5	3	5	8	11	10	8
Wallops Station	2	2	2	2	2	1	1	2	1	2	2
Subtotal C[d]	16	17	16	13	7	4	6	10	12	12	10
Marshall Space Flight Center	31	41	46	50	44	37	32	27	26	21	23
Manned Spacecraft Center	46	49	60	69	69	148	195	214	203	192	188
Kennedy Space Center	8	7	6	6	5	7	7	5	4	5	5
Subtotal D[d]	85	97	112	125	118	192	234	246	233	218	216
Total military detailees, NASA	216	239	250	249	222	280	305	323	309	318	317
Jet Propulsion Laboratory	17	17	17	17	17	16	16	16	19	19	13

[a-d] Notes are identical to Table 3-8. See Chapter Six for a separate personnel summary for each installation. JPL data supplied by JPL Personnel Office.

Table 3-16. Scientific and Technological Permanent Personnel (Code Groups 200, 700, 900) by NASA Installation*
(number on board)

Installation[a]	1958		1959		1960		1961		1962	
	9/30	12/31	9/30	12/31	9/30	12/31	9/30	12/31	9/30	12/31
Headquarters	37	57	105	120	129	161	187	221	329	452
NASA Pasadena Office	---	---	---	---	---	---	---	---	---	---
Western Support Office[b]	---	---	---	---	11	13	15	19	29	32
Other Western offices[c]	---	---	---	---	---	---	---	---	---	5
Subtotal A[d]	37	57	105	120	140	174	202	240	358	489
Langley Research Center	1149	1162	1344	1155	1130	1127	1189	1193	1365	1422
Ames Research Center	435	435	453	446	456	441	471	506	582	628
Lewis Research Center	948	949	974	936	932	921	928	1041	1431	1575
Flight Research Center	79	83	87	91	110	122	138	148	161	174
Electronics Research Center	---	---	---	---	---	---	---	---	---	---
AEC-NASA Space Nuclear Propulsion Office	---	---	---	---	---	---	---	12	27	36
Subtotal B[d]	2611	2629	2858	2628	2628	2611	2726	2900	3566	3835
Goddard Space Flight Center	---	128	215	610	682	848	627	726	1022	1149
Wallops Station	---	---	---	---	28	45	46	49	57	58
Subtotal C[d]	---	128	215	610	710	893	673	775	1079	1207
Marshall Space Flight Center	---	---	---	---	15	1486	1714	1855	2194	2334
Manned Spacecraft Center	---	---	---	---	---	---	354	469	785	1116
Kennedy Space Center	---	---	---	---	---	---	---	---	---	165
Subtotal D[d]	---	---	---	---	15	1486	2068	2324	2979	3615
Total personnel in category	2648	2814	3178	3358	3493	5164	5669	6239	7982	9146

Table 3-16. Scientific and Technological Permanent Personnel (Code Groups 200, 700, 900) by NASA Installation* (Continued)
(number on board)

Installation[a]	1963		1964		1965		1966		1967		1968
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Headquarters	516	543	532	523	539	547	547	561	553	553	541
NASA Pasadena Office	----	----	----	2	3	3	8	8	9	9	9
Western Support Office[b]	37	40	53	54	53	52	45	17	15	15	----
Other Western offices[c]	5	5	5	6	6	----	----	1	----	----	----
Subtotal A[d]	558	588	590	585	601	602	600	587	577	577	550
Langley Research Center	1 536	1 582	1 603	1 612	1 650	1 641	1 652	1 630	1 643	1 636	1 610
Ames Research Center	721	789	814	814	825	827	859	881	887	903	885
Lewis Research Center	1 849	1 936	1 960	1 947	1 958	1 902	1 924	1 883	1 894	1 856	1 814
Flight Research Center	192	199	199	202	200	202	203	204	203	200	198
Electronics Research Center	4	5	6	44	94	138	217	268	338	373	400
AEC-NASA Space Nuclear Propulsion Office	51	55	59	59	59	58	59	59	58	64	59
Subtotal B[d]	4 353	4 566	4 641	4 678	4 786	4 768	4 914	4 925	5 023	5 032	4 966
Goddard Space Flight Center	1 376	1 499	1 609	1 644	1 692	1 590	1 718	1 755	1 796	1 791	1 818
Wallops Station	70	75	81	82	84	85	85	81	82	81	90
Subtotal C[d]	1 446	1 574	1 690	1 726	1 776	1 675	1 803	1 836	1 878	1 872	1 908
Marshall Space Flight Center	2 486	2 590	2 735	2 788	2 751	2 696	2 740	2 773	2 774	2 791	2 606
Manned Spacecraft Center	1 471	1 621	2 002	2 357	2 184	2 226	2 383	2 404	2 505	2 515	2 504
Kennedy Space Center	381	453	591	746	1 017	1 085	1 116	1 112	1 199	1 199	1 327
Subtotal D[d]	4 338	4 664	5 328	5 891	5 952	6 007	6 239	6 289	6 478	6 505	6 437
Total personnel in category	10 695	11 392	12 2[illegible]	12 880	13 115	13 052	13 556	13 637	13 956	13 986	13 851

*See introduction to this chapter for a full description of code groups.

[a-d] Notes are identical to those for Table 3-8. See Chapter Six for a separate personnel summary for each installation.

Table 3-17. Scientific and Technological Permanent Personnel (Code Groups 200, 700, 900) by NASA Installation (percentage of NASA total[a])

Installation[a]	1958		1959		1960		1961		1962	
	9/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31
Headquarters	1.4	2.0	3.3	3.6	3.7	3.1	3.3	3.5	4.1	4.9
NASA Pasadena Office	---	---	---	---	---	---	---	---	---	---
Western Support Office[b]	---	---	---	---	0.3	0.3	0.3	0.3	0.4	0.3
Other Western offices[c]	---	---	---	---	---	---	---	---	---	0.1
Subtotal A[d]	1.4	2.0	3.3	3.6	4.0	3.4	3.6	3.8	4.5	5.3
Langley Research Center	43.4	41.3	42.3	34.4	32.4	21.8	21.0	19.1	17.1	15.5
Ames Research Center	16.4	15.5	14.3	13.3	13.1	8.5	8.3	8.1	7.3	6.9
Lewis Research Center	35.8	33.7	30.6	27.9	26.7	17.8	16.4	16.7	17.9	17.2
Flight Research Center	3.0	2.9	2.7	2.7	3.1	2.4	2.4	2.4	2.0	1.9
Electronics Research Center	---	---	---	---	---	---	---	---	---	---
AEC-NASA Space Nuclear Propulsion Office	---	---	---	---	---	---	---	0.2	0.3	0.4
Subtotal B[d]	98.6	93.4	89.9	78.3	75.2	50.6	48.1	46.5	44.7	41.9
Goddard Space Flight Center	---	4.5	6.8	18.2	19.5	16.4	11.1	11.6	12.8	12.6
Wallops Station	---	---	---	---	0.8	0.9	0.8	0.8	0.7	0.6
Subtotal C[d]	---	4.5	6.8	18.2	20.3	17.3	11.9	12.4	13.5	13.2
Marshall Space Flight Center	---	---	---	---	0.4	28.8	30.2	29.7	27.5	25.5
Manned Spacecraft Center	---	---	---	---	---	---	6.2	7.5	9.8	12.2
Kennedy Space Center	---	---	---	---	---	---	---	---	---	1.8
Subtotal D[d]	---	---	---	---	0.4	28.8	36.5	37.2	37.3	39.5
Total personnel in category	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 3-17. Scientific and Technological Permanent Personnel (Code Groups 200, 700, 900) by NASA Installation (Continued)
(percentage of NASA total*)

Installation[a]	1963		1964		1965		1966		1967		1968
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Headquarters	4.8	4.8	4.3	4.0	4.1	4.2	4.0	4.1	4.0	4.0	3.9
NASA Pasadena Office	---	---	---	*	*	*	0.1	0.1	0.1	0.1	0.1
Western Support Office[b]	0.3	0.4	0.4	0.4	0.4	0.4	0.3	0.1	0.1	0.1	---
Other Western offices[c]	*	*	*	*	*	---	---	*	---	---	---
Subtotal A[d]	5.2	5.2	4.8	4.5	4.6	4.6	4.4	4.3	4.1	4.1	4.0
Langley Research Center	14.4	13.9	13.1	12.4	12.6	12.6	12.2	12.0	11.7	11.7	11.6
Ames Research Center	6.7	6.9	6.6	6.3	6.3	6.3	6.3	6.5	6.4	6.5	6.4
Lewis Research Center	17.3	17.0	16.0	15.0	14.9	14.6	14.2	13.8	13.6	13.2	13.1
Flight Research Center	1.8	1.7	1.6	1.6	1.5	1.5	1.5	1.5	1.5	1.4	1.4
Electronics Research Center	*	*	*	0.3	0.7	1.1	1.6	2.0	2.4	2.7	2.9
AEC-NASA Space Nuclear Propulsion Office	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.5	0.4
Subtotal B[d]	40.7	40.1	37.9	36.3	36.5	36.5	36.2	36.1	36.0	36.0	35.9
Goddard Space Flight Center	12.9	13.2	13.1	12.7	12.9	12.2	12.7	12.9	12.8	12.8	13.1
Wallops Station	0.7	0.7	0.7	0.6	0.6	0.7	0.6	0.6	0.6	0.6	0.6
Subtotal C[d]	13.5	13.8	13.8	13.4	13.5	12.8	13.3	13.5	13.5	13.4	13.8
Marshall Space Flight Center	23.2	22.7	22.3	21.5	21.0	20.7	20.2	20.3	20.0	20.0	18.8
Manned Spacecraft Center	13.8	14.2	16.3	18.2	16.7	17.0	17.6	17.6	17.9	18.0	18.1
Kennedy Space Center	3.6	4.0	4.8	5.8	7.8	8.3	8.2	8.2	8.6	8.6	9.6
Subtotal D[d]	40.6	40.9	43.5	45.7	45.4	46.0	46.0	46.1	46.4	46.5	46.5
Total personnel in category	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

*Percentages are rounded to nearest tenth of one percent and thus may not add to totals. An asterisk in the column indicates less than 0.05 percent.

[a-d] Notes are identical to those for Table 3-8.

Source: Table 3-16.

Table 3-18. Technical Support Permanent Personnel (Code Group 300) by NASA Installation*
(number on board)

Installation[a]	1958		1959		1960		1961		1962	
	9/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31
Headquarters	1	1	4	4	5	5	8	14	19	24
NASA Pasadena Office	----	----	----	----	----	----	----	----	----	----
Western Support Office[b]	----	----	----	----	0	0	0	1	5	51
Other Western offices[c]	----	----	----	----	----	----	----	----	----	1
Subtotal A[d]	1	1	4	4	5	5	8	15	24	76
Langley Research Center	266	290	302	268	243	275	291	337	412	414
Ames Research Center	159	162	163	151	147	149	157	167	179	191
Lewis Research Center	265	257	258	247	233	289	308	287	362	366
Flight Research Center	21	19	23	25	33	27	39	31	42	36
Electronics Research Center	----	----	----	----	----	----	----	----	----	----
AEC-NASA Space Nuclear Propulsion Office	----	----	----	----	----	----	----	0	0	0
Subtotal B[d]	711	728	746	691	656	740	795	822	995	1007
Goddard Space Flight Center	----	53	88	154	161	215	202	261	355	404
Wallops Station	----	----	----	----	17	35	31	43	44	51
Subtotal C[d]	----	53	88	154	178	250	233	304	399	455
Marshall Space Flight Center	----	----	----	----	74	748	857	932	1077	1033
Manned Spacecraft Center	----	----	----	----	----	----	57	84	149	207
Kennedy Space Center	----	----	----	----	----	----	----	----	----	39
Subtotal D[d]	----	----	----	----	74	748	914	1016	1226	1279
Total personnel in category	712	782	838	849	913	1743	1950	2157	2644	2817

Table 3-18. Technical Support Permanent Personnel (Code Group 300) by NASA Installation* (Continued)
(number on board)

Installation*	1963		1964		1965		1966		1967		1968
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Headquarters	27	27	18	15	13	7	8	7	11	8	8
NASA Pasadena Office	----	----	----	0	0	0	0	0	0	0	0
Western Support Office[b]	76	77	88	88	87	84	81	0	0	1	----
Other Western offices[c]	1	2	2	3	2	----	----	69	----	----	----
Subtotal A[d]	104	106	108	106	102	91	89	76	11	9	8
Langley Research Center	430	452	468	492	507	514	965	985	1022	994	1022
Ames Research Center	208	215	198	199	209	199	185	181	180	202	213
Lewis Research Center	399	430	417	394	390	408	377	370	361	348	358
Flight Research Center	67	50	62	61	65	60	59	58	49	68	73
Electronics Research Center	2	3	3	4	11	13	30	42	64	66	77
AEC-NASA Space Nuclear Propulsion Office	0	0	0	0	0	0	0	0	0	0	0
Subtotal B[d]	1106	1150	1148	1150	1182	1194	1616	1636	1676	1678	1743
Goddard Space Flight Center	484	516	541	538	558	548	544	555	534	526	552
Wallops Station	75	65	71	63	161	175	175	185	176	188	186
Subtotal C[d]	559	581	612	601	719	723	719	740	710	714	738
Marshall Space Flight Center	1283	1122	1131	1138	1126	1140	1092	1067	956	1000	908
Manned Spacecraft Center	333	386	476	516	480	484	504	537	465	451	497
Kennedy Space Center	123	146	172	232	270	387	409	429	415	417	454
Subtotal D[d]	1739	1654	1779	1886	1876	2011	2005	2033	1836	1868	1859
Total personnel in category	3508	3491	3647	3742	3879	4019	4429	4485	4234	4269	4348

*See introduction to this chapter for a full description of code groups.

[a-d] Notes are identical to those for Table 3-8. See Chapter Six for a separate personnel summary for each installation.

Table 3-19. Technical Support Permanent Personnel (Code Group 300) by NASA Installation
(percentage of NASA total*)

Installation[a]	1958		1959		1960		1961		1962	
	9/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31
Headquarters	0.1	0.1	0.5	0.5	0.5	0.3	0.4	0.6	0.7	0.9
NASA Pasadena Office	---	---	---	---	---	---	---	---	---	---
Western Support Office[b]	---	---	---	---	0.0	0.0	0.0	*	0.2	1.8
Other Western offices[c]	---	---	---	---	---	---	---	---	---	*
Subtotal A[d]	0.1	0.0	0.5	0.5	0.5	0.3	0.4	0.7	0.9	2.7
Langley Research Center	37.4	37.1	36.0	31.6	26.6	15.8	14.9	15.6	15.6	14.7
Ames Research Center	22.3	20.7	19.5	17.8	16.1	8.5	8.1	7.7	6.8	6.8
Lewis Research Center	37.2	32.9	30.8	29.1	25.5	16.6	15.8	13.3	13.7	13.0
Flight Research Center	2.9	2.4	2.7	2.9	3.6	1.5	2.0	1.4	1.6	1.3
Electronics Research Center	---	---	---	---	---	---	---	---	---	---
AEC-NASA Space Nuclear Propulsion Office	---	---	---	---	---	---	---	0.0	0.0	0.0
Subtotal B[d]	99.9	93.1	89.0	81.4	71.9	42.5	40.8	38.1	37.6	35.7
Goddard Space Flight Center	---	6.7	10.5	18.1	17.6	12.3	10.4	12.1	13.4	14.3
Wallops Station	---	---	---	---	1.9	2.0	1.6	2.0	1.7	1.8
Subtotal C[d]	---	6.7	10.5	18.1	19.5	14.3	11.9	14.1	15.1	16.2
Marshall Space Flight Center	---	---	---	---	8.1	42.9	43.9	43.2	40.7	36.7
Manned Spacecraft Center	---	---	---	---	---	---	2.9	3.9	5.6	7.3
Kennedy Space Center	---	---	---	---	---	---	---	---	---	1.4
Subtotal D[d]	---	---	---	---	8.1	42.9	46.9	47.1	46.4	45.4
Total personnel in category	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 3-19. Technical Support Permanent Personnel (Code Group 300) by NASA Installation (Continued)
(percentage of NASA total*)

Installation[a]	1963		1964		1965		1966		1967		1968
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Headquarters	0.8	0.8	0.5	0.4	0.3	0.2	0.2	0.2	0.3	0.2	0.2
NASA Pasadena Office	---	---	---	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Western Support Office[b]	2.2	2.2	2.4	2.4	2.2	2.1	1.8	0.0	0.0	*	---
Other Western offices[c]	*	0.1	0.1	0.1	0.1	---	---	1.5	---	---	---
Subtotal A[d]	3.0	3.0	3.0	2.8	2.6	2.3	2.0	1.7	0.3	0.2	0.2
Langley Research Center	12.3	12.9	12.8	13.1	13.1	12.8	21.8	22.0	24.1	23.3	23.5
Ames Research Center	5.9	6.2	5.4	5.3	5.4	5.0	4.2	4.0	4.3	4.7	4.9
Lewis Research Center	11.4	12.3	11.4	10.5	10.1	10.2	8.5	8.2	8.5	8.2	8.2
Flight Research Center	1.9	1.4	1.7	1.6	1.7	1.5	1.3	1.3	1.2	1.6	1.7
Electronics Research Center	0.1	0.1	0.1	0.1	0.3	0.3	0.7	0.9	1.5	1.5	1.8
AEC-NASA Space Nuclear Propulsion Office	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Subtotal B[d]	31.5	32.9	31.5	30.7	30.5	29.7	36.5	36.5	39.6	39.3	40.0
Goddard Space Flight Center	13.8	14.8	14.8	14.4	14.4	13.6	12.3	12.4	12.6	12.3	12.7
Wallops Station	2.1	1.9	1.9	1.7	4.2	4.4	4.0	4.1	4.2	4.4	4.3
Subtotal C[d]	15.9	16.6	16.8	16.1	18.5	18.0	16.2	16.5	16.8	16.7	16.9
Marshall Space Flight Center	36.6	32.1	31.0	30.4	29.0	28.4	24.7	23.8	22.6	23.4	20.8
Manned Spacecraft Center	9.5	11.1	13.1	13.8	12.4	12.0	11.4	12.0	11.0	10.6	11.4
Kennedy Space Center	3.5	4.2	4.7	6.2	7.0	9.6	9.2	9.6	9.8	9.8	10.4
Subtotal D[d]	49.6	47.4	48.8	50.4	48.4	50.0	45.3	45.3	43.4	43.8	42.7
Total personnel in category	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

*Percentages are rounded to nearest tenth of one percent and thus may not add to totals. An asterisk in the column indicates less than 0.05 percent.

[a-d] Notes are identical to those for Table 3-8.

Source: Table 3-18.

Table 3-20. Trades and Labor Permanent Employees (Code Group 100) by NASA Installation[a]
(number on board)

Installation[a]	1958		1959		1960		1961		1962	
	9/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31
Headquarters	4	7	9	10	12	12	12	15	17	17
NASA Pasadena Office	---	---	---	---	---	---	---	---	---	---
Western Support Office[b]	---	---	---	---	0	0	0	0	0	0
Other Western offices[c]	---	---	---	---	---	---	---	---	---	0
Subtotal A[d]	4	7	9	10	12	12	12	15	17	17
Langley Research Center	1545	1609	1656	1604	1452	1439	1422	1470	1480	1578
Ames Research Center	617	628	635	635	628	631	630	644	662	720
Lewis Research Center	1174	1169	1235	1228	1218	1235	1236	1343	1500	1576
Flight Research Center	134	145	148	151	195	199	204	234	243	260
Electronics Research Center	---	---	---	---	---	---	---	---	---	---
AEC-NASA Space Nuclear Propulsion Office	---	---	---	---	---	---	---	0	0	0
Subtotal B[d]	3470	3551	3674	3618	3493	3504	3492	3691	3885	4134
Goddard Space Flight Center	---	2	4	83	96	208	129	185	219	245
Wallops Station	---	---	---	---	133	147	160	192	201	218
Subtotal C[d]	---	2	4	83	229	355	289	377	420	463
Marshall Space Flight Center	---	---	---	---	7	1925	1764	1734	1693	1615
Manned Spacecraft Center	---	---	---	---	---	---	123	148	167	212
Kennedy Space Center	---	---	---	---	---	---	---	---	---	31
Subtotal D[d]	---	---	---	---	7	1925	1887	1882	1860	1858
Total personnel in category	3474	3560	3687	3711	3741	5796	5680	5965	6182	6472

Table 3-20. Trades and Labor Permanent Employees (Code Group 100) by NASA Installation* (Continued)
(number on board)

Installation*	1963		1964		1965		1966		1967		1968
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Headquarters	21	20	20	18	17	17	20	26	25	21	20
NASA Pasadena Office	---	---	---	0	0	0	0	0	0	0	0
Western Support Office[b]	0	0	0	0	0	0	1	1	1	1	---
Other Western offices[c]	0	0	0	0	0	---	---	0	---	---	---
Subtotal A[d]	21	20	20	18	17	17	21	27	26	22	20
Langley Research Center	1566	1569	1546	1542	1501	1426	964	910	865	854	761
Ames Research Center	738	758	775	759	766	743	722	694	685	640	587
Lewis Research Center	1710	1713	1746	1755	1741	1758	1775	1771	1739	1701	1635
Flight Research Center	263	273	262	259	253	247	241	241	233	212	198
Electronics Research Center	0	0	0	0	0	1	7	9	9	10	11
AEC-NASA Space Nuclear Propulsion Office	0	0	0	0	0	0	0	0	0	0	0
Subtotal B[d]	4277	4313	4329	4315	4261	4175	3709	3625	3531	3417	3192
Goddard Space Flight Center	245	257	260	253	255	254	245	232	228	219	217
Wallops Station	228	243	254	262	168	142	140	124	120	106	103
Subtotal C[d]	473	500	514	515	423	396	385	356	348	325	320
Marshall Space Flight Center	1565	1530	1477	1450	1424	1346	1239	1146	1065	968	835
Manned Spacecraft Center	267	246	310	326	239	229	208	205	212	190	148
Kennedy Space Center	67	60	57	27	97	13	4	3	3	4	3
Subtotal D[d]	1899	1836	1844	1803	1760	1588	1451	1354	1280	1162	986
Total personnel in category	6670	6669	6707	6651	6461	6176	5566	5362	5185	4926	4518

*See introduction to this chapter for a full description of code groups.

[a-d] Notes are identical to those for Table 3-8. See Chapter Six for a separate personnel summary for each installation.

Table 3-21. Trades and Labor Permanent Employees (Code Group 100) by NASA Installation
(percentage of NASA total[*])

Installation[a]	1958		1959		1960		1961		1962	
	9/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31
Headquarters	0.1	0.2	0.2	0.3	0.3	0.2	0.2	0.3	0.3	0.3
NASA Pasadena Office	---	---	---	---	---	---	---	---	---	---
Western Support Office[b]	---	---	---	---	0.0	0.0	0.0	0.0	0.0	0.0
Other Western offices[c]	---	---	---	---	---	---	---	---	---	0.0
Subtotal A[d]	0.1	0.2	0.2	0.3	0.3	0.2	0.2	0.3	0.3	0.3
Langley Research Center	44.5	45.2	44.9	43.2	38.8	24.8	25.0	24.6	23.9	24.4
Ames Research Center	17.8	17.6	17.2	17.1	16.8	10.9	11.1	10.8	10.7	11.1
Lewis Research Center	33.8	32.8	33.5	33.1	32.6	21.3	21.8	22.5	24.3	24.4
Flight Research Center	3.9	4.1	4.0	4.1	5.2	3.4	3.6	3.9	3.9	4.0
Electronics Research Center	---	---	---	---	---	---	---	---	---	---
AEC-NASA Space Nuclear Propulsion Office	---	---	---	---	---	---	---	0.0	0.0	0.0
Subtotal B[d]	99.7	99.7	99.6	97.5	93.4	60.5	61.5	61.9	62.8	63.9
Goddard Space Flight Center	---	0.1	0.1	2.2	2.6	3.6	2.3	3.1	3.5	3.8
Wallops Station	---	---	---	---	3.6	2.5	2.8	3.2	3.3	3.4
Subtotal C[d]	---	0.1	0.1	2.2	6.1	6.1	5.1	6.3	6.8	7.2
Marshall Space Flight Center	---	---	---	---	0.2	33.2	31.1	29.1	27.4	25.0
Manned Spacecraft Center	---	---	---	---	---	---	2.2	2.5	2.7	3.3
Kennedy Space Center	---	---	---	---	---	---	---	---	---	0.5
Subtotal D[d]	---	---	---	---	0.2	33.2	33.2	31.6	30.1	28.7
Total personnel in category	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 3-21. Trades and Labor Permanent Employees (Code Group 100) by NASA Installation (Continued)
(percentage of NASA total*)

Installation[a]	1963		1964		1965		1966		1967		1968
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Headquarters	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.5	0.5	0.4	0.4
NASA Pasadena Office	---	---	---	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Western Support Office[b]	0.0	0.0	0.0	0.0	0.0	0.0	*	*	*	*	---
Other Western offices[c]	0.0	0.0	0.0	0.0	0.0	---	---	0.0	---	---	---
Subtotal A[d]	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.5	0.5	0.4	0.4
Langley Research Center	23.5	23.5	23.1	23.2	23.2	23.1	17.3	17.0	16.7	17.3	16.8
Ames Research Center	11.1	11.4	11.6	11.4	11.9	12.0	13.0	12.9	13.2	13.0	13.0
Lewis Research Center	25.6	25.7	26.0	26.4	26.9	28.5	31.9	33.0	33.5	34.5	36.2
Flight Research Center	3.9	4.1	3.9	3.9	3.9	4.0	4.3	4.5	4.5	4.3	4.4
Electronics Research Center	0.0	0.0	0.0	0.0	0.0	*	0.1	0.2	0.2	0.2	0.2
AEC-NASA Space Nuclear Propulsion Office	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Subtotal B[d]	64.1	64.7	64.5	64.9	65.9	67.6	66.6	67.6	68.1	69.4	70.7
Goddard Space Flight Center	3.7	3.9	3.9	3.8	3.9	4.1	4.4	4.3	4.4	4.4	4.8
Wallops Station	3.4	3.6	3.8	3.9	2.6	2.3	2.5	2.3	2.3	2.2	2.3
Subtotal C[d]	7.1	7.5	7.7	7.7	6.5	6.4	6.9	6.6	6.7	6.6	7.1
Marshall Space Flight Center	23.5	22.9	22.0	21.8	22.0	21.8	22.3	21.4	20.5	19.7	18.5
Manned Spacecraft Center	4.0	3.7	4.6	4.9	3.7	3.7	3.7	3.8	4.1	3.9	3.3
Kennedy Space Center	1.0	0.9	0.8	0.4	1.5	0.2	0.1	0.1	0.1	0.1	0.1
Subtotal D[d]	28.5	27.5	27.5	27.1	27.2	25.7	26.1	25.3	24.7	23.6	21.8
Total personnel in category	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

*Percentages are rounded to nearest tenth of one percent and thus may not add to totals. An asterisk in the column indicates less than 0.05 percent.

[a-d] Notes are identical to those for Table 3-8.

Source: Table 3-20.

Table 3-22. Administrative and Clerical Permanent Personnel (Code Groups 600 and 500) by NASA Installation*
(number on board)

Installation[a]	1958		1959		1960		1961		1962	
	9/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31
Headquarters	134	202	302	343	415	467	509	672	956	1148
NASA Pasadena Office	---	---	---	---	---	---	---	---	---	---
Western Support Office[b]	---	---	---	---	25	36	42	60	96	158
Other Western offices[c]	---	---	---	---	---	---	---	---	---	6
Subtotal A[d]	134	202	302	343	440	503	551	732	1952	1312
Langley Research Center	362	397	463	425	364	360	393	441	509	570
Ames Research Center	175	181	188	181	173	176	171	185	208	249
Lewis Research Center	316	312	335	330	320	278	279	330	428	508
Flight Research Center	46	47	54	50	54	53	54	64	71	82
Electronics Research Center	---	---	---	---	---	---	---	---	---	---
AEC-NASA Space Nuclear Propulsion Office	---	---	---	---	---	---	---	3	12	30
Subtotal B[d]	899	937	1040	986	911	867	897	1023	1228	1439
Goddard Space Flight Center	---	31	78	249	313	470	362	539	691	781
Wallops Station	---	---	---	---	50	50	55	75	81	82
Subtotal C[d]	---	31	78	249	363	520	417	614	772	863
Marshall Space Flight Center	---	---	---	---	224	1089	1187	1390	1705	1676
Manned Spacecraft Center	---	---	---	---	---	---	186	334	487	704
Kennedy Space Center	---	---	---	---	---	---	---	---	---	325
Subtotal D[d]	---	---	---	---	224	1089	1373	1724	2192	2705
Total personnel in category	1033	1170	1420	1578	1938	2979	3237	4093	5244	6319

Table 3-22. Administrative and Clerical Permanent Personnel (Code Groups 600 and 500) by NASA Installation* (Continued)
(number on board)

Installation*	1963		1964		1965		1966		1967		1968
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Headquarters	1282	1362	1408	1410	1429	1448	1506	1 558	1 549	1511	1508
NASA Pasadena Office	---	---	---	14	15	17	71	79	77	78	67
Western Support Office[b]	188	193	228	213	212	203	141	79	82	78	---
Other Western offices[c]	7	9	10	10	9	---	---	55	---	---	---
Subtotal A[d]	1477	1564	1646	1647	1665	1668	1718	1 771	1 708	1667	1575
Langley Research Center	580	601	638	652	627	656	699	710	697	684	644
Ames Research Center	297	348	365	364	375	386	425	433	421	419	399
Lewis Research Center	619	656	682	710	726	710	743	732	710	678	645
Flight Research Center	91	94	95	98	93	99	106	104	102	102	97
Electronics Research Center	18	21	23	69	133	179	216	251	289	295	306
AEC-NASA Space Nuclear Propulsion Office	43	46	48	51	56	54	55	55	54	51	49
Subtotal B[d]	1648	1766	1851	1944	2010	2084	2244	2 285	2 273	2229	2140
Goddard Space Flight Center	925	1038	1088	1096	1108	1097	1211	1 212	1 230	1166	1159
Wallops Station	100	100	113	106	107	107	112	116	121	121	118
Subtotal C[d]	1025	1138	1201	1202	1215	1204	1323	1 328	1 351	1287	1277
Marshall Space Flight Center	1909	1903	2124	2141	2184	2227	2345	2 356	2 358	2267	2051
Manned Spacecraft Center	988	1044	1246	1406	1371	1386	1453	1 503	1 536	1450	1439
Kennedy Space Center	438	515	614	722	797	847	904	995	1 076	1091	1143
Subtotal D[d]	3335	3462	3984	4269	4352	4460	4702	4 854	4 970	4808	4633
Total personnel in category	7485	7930	8682	9062	9242	9416	9987	10 238	10 302	9991	9625

*See introduction to this chapter for a full description of code groups and explanation for combining 500 and 600 code groups.

[a-d] Notes are identical to those for Table 3-8. See Chapter Six for a separate personnel summary for each installation.

Table 3-23. Administrative and Clerical Permanent Personnel (Code Groups 600 and 500) by NASA Installation
(percentage of NASA total[e])

Installation[a]	1958		1959		1960		1961		1962	
	9/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31
Headquarters	13.0	17.3	21.3	21.7	21.5	15.7	15.7	16.4	18.2	18.2
NASA Pasadena Office	---	---	---	---	---	---	---	---	---	---
Western Support Office[b]	---	---	---	---	1.3	1.2	1.3	1.5	1.8	2.5
Other Western offices[c]	---	---	---	---	---	---	---	---	---	0.1
Subtotal A[d]	13.0	17.3	21.3	21.7	22.7	16.9	17.0	17.9	20.1	20.8
Langley Research Center	35.0	33.9	32.6	26.9	18.9	12.1	12.1	10.8	9.7	9.0
Ames Research Center	16.9	15.5	13.2	11.5	9.0	5.9	5.3	4.5	4.0	3.9
Lewis Research Center	30.6	26.7	23.6	20.9	16.6	9.3	8.6	8.1	8.2	8.0
Flight Research Center	4.5	4.0	3.8	3.2	2.8	1.8	1.7	1.6	1.4	1.3
Electronics Research Center	---	---	---	---	---	---	---	---	---	---
AEC-NASA Space Nuclear Propulsion Office	---	---	---	---	---	---	---	0.1	0.2	0.5
Subtotal B[d]	87.0	80.1	73.2	62.5	47.0	29.1	27.7	25.0	23.4	22.8
Goddard Space Flight Center	---	2.6	5.5	15.8	16.2	15.8	11.2	13.2	13.2	12.4
Wallops Station	---	---	---	---	2.6	1.7	1.7	1.8	1.5	1.3
Subtotal C[d]	---	2.6	5.5	15.8	18.7	17.5	12.9	10.2	14.7	13.7
Marshall Space Flight Center	---	---	---	---	11.6	36.6	36.7	34.0	32.5	26.5
Manned Spacecraft Center	---	---	---	---	---	---	5.7	8.2	9.3	11.1
Kennedy Space Center	---	---	---	---	---	---	---	---	---	5.1
Subtotal D[d]	---	---	---	---	11.6	36.6	42.4	42.1	41.8	42.8
Total personnel in category	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 3-23. Administrative and Clerical Permanent Personnel (Code Groups 600 and 500) by NASA Installation (Continued)
(percentage of NASA total[a])

Installation[a]	1963 6/30	1963 12/31	1964 6/30	1964 12/31	1965 6/30	1965 12/31	1966 6/30	1966 12/31	1967 6/30	1967 12/31	1968 6/30
Headquarters	17.1	17.2	16.2	15.6	15.5	15.4	15.1	15.2	15.0	15.1	15.7
NASA Pasadena Office	---	---	---	0.2	0.2	0.2	0.7	0.8	0.7	0.8	0.7
Western Support Office[b]	2.5	2.4	2.6	2.3	2.3	2.2	1.4	0.8	0.8	0.8	---
Other Western offices[c]	0.1	0.1	0.1	0.1	0.1	---	---	0.5	---	---	---
Subtotal A[d]	19.7	19.7	19.0	18.2	18.0	17.7	17.2	17.3	16.6	16.7	16.4
Langley Research Center	7.7	7.6	7.3	7.2	6.8	7.0	7.0	6.9	6.8	6.8	6.7
Ames Research Center	4.0	4.4	4.2	4.0	4.1	4.1	4.2	4.2	4.1	4.2	4.1
Lewis Research Center	8.3	8.3	7.9	7.8	7.9	7.5	7.4	7.1	6.9	6.8	6.7
Flight Research Center	1.2	1.2	1.1	1.1	1.0	1.1	1.1	1.0	1.0	1.0	1.0
Electronics Research Center	0.2	0.3	0.3	0.8	1.4	1.9	2.2	2.5	2.8	3.0	3.2
AEC-NASA Space Nuclear Propulsion Office	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.5
Subtotal B[d]	22.0	22.3	21.3	21.5	21.7	22.1	22.5	22.3	22.1	22.3	22.2
Goddard Space Flight Center	12.4	13.1	12.5	12.1	12.0	11.7	12.1	10.9	11.9	11.7	12.0
Wallops Station	1.3	1.3	1.3	1.2	1.2	1.1	1.1	1.1	1.2	1.2	1.2
Subtotal C[d]	13.7	14.4	13.8	13.3	13.1	12.8	13.2	13.0	13.1	12.9	13.3
Marshall Space Flight Center	25.5	24.0	24.5	23.6	23.6	23.7	23.5	23.0	22.9	22.7	21.3
Manned Spacecraft Center	13.2	13.2	14.4	15.5	14.8	14.7	14.5	14.7	14.9	14.5	15.0
Kennedy Space Center	5.9	6.5	7.1	8.0	8.6	9.0	9.1	9.7	10.4	10.9	11.8
Subtotal D[d]	44.6	43.7	45.9	47.1	47.1	47.4	47.1	47.4	48.2	48.1	48.1
Total personnel in category	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[a] Percentages are rounded to nearest tenth of one percent and thus may not add to totals.

[b-d] Notes are identical to those for Table 3-8.

Source: Table 3-22.

Table 3-24. Permanent Civil Service Positions by NASA Program
(positions budgeted for end of fiscal year)

Program[a]	1961[b]	1962	1963	1964	1965	1966	1967	1968
Administrative support	c	c	4 068	4 411	4 872	5 203	5 487	5 125
Research and development support	c	c	4 147	6 538	4 936	4 393	4 376	4 202
Other support	c	c	445	472	1 092	1 148	920	899
Subtotal	c	c	8 660	11 421	10 900	10 744	10 783	10 226
Sustaining university program	---	32	55	68	72	76	57	54
Technology utilization	---	36	37	50	47	57	51	47
Tracking and data acquisition	1 053	1 007	698	851	780	1 041	976	958
Subtotal	1 053	1 075	790	969	899	1 174	1 084	1 059
Space power/electric propulsion	594	1 856	922	804	931	902	948	925
Nuclear rockets	910	901	626	530	774	676	409	198
Space vehicle systems	1 722	2 945	1 836	1 389	1 483	1 502	1 462	1 362
Electronics systems	---	1 499	1 098	906	1 068	1 182	1 133	1 123
Aeronautics	2 744	1 984	1 530	1 394	1 513	1 775	2 118	2 270
Human factor systems	---	196	142	214	230	354	383	374
Chemical propulsion	1 086	806	503	425	505	459	367	376
Basic research	---	---	1 402	1 268	1 258	1 234	1 284	1 243
Subtotal	7 056	10 187	8 059	6 930	7 762	8 084	8 104	7 871
Space applications	338	616	410	480	429	437	515	591
Launch vehicle development	440	1 024	615	340	265	132	182	---
Lunar and planetary exploration	379	193	179	296	342	300	405	284
Physics and astronomy	1 651	1 324	1 048	1 234	1 357	1 364	1 401	1 362
Bioscience	---	65	207	240	260	273	271	276
Launch vehicle procurement	---	---	---	324	317	510	445	476
Subtotal	2 808	3 222	2 459	2 914	2 970	3 016	3 219	2 989
Mercury	1 195	747	---	---	---	---	---	---
Gemini	---	263	512	1 141	1 050	1 130	30	---
Apollo	4 632	6 662	6 876	8 266	9 369	9 348	9 300	7 937
Apollo applications	---	---	---	---	---	160	888	2 015
Other manned space flight	---	---	548	343	250	268	318	325
Subtotal	5 827	7 672	7 936	9 750	10 669	10 906	10 536	10 277
Total, all programs	16 744	22 156	27 904	31 984	33 200	33 924	33 726	32 422

[a] Corresponds closely to the budget line item used for FY 1968. No data available before 1961.

[b] Column only roughly comparable to subsequent columns because of organizational and program changes in November 1961.

[c] Support positions included in program totals. Program totals thus inflated when compared with subsequent years.

Source: Based on information supplied by the NASA Installation Analysis Branch, BR-2.

Table 3-25. Permanent Civil Service Positions by NASA Program
(percentage of total end of fiscal year positions)

Program[a]	1961[b]	1962	1963	1964	1965	1966	1967	1968
Administrative support	c	c	14.6	13.8	14.7	15.3	16.3	15.8
Research and development support	c	c	14.9	20.4	14.9	12.9	13.0	13.0
Other support	c	c	1.6	1.5	3.3	3.4	2.7	2.8
Subtotal	c	c	31.0	35.7	32.8	31.7	32.0	31.5
Sustaining university program		0.1	0.2	0.2	0.2	0.2	0.2	0.2
Technology utilization		0.2	0.1	0.2	0.1	0.2	0.2	0.1
Tracking and data acquisition		4.5	2.5	2.7	2.3	3.1	2.9	3.0
Subtotal	6.3	4.9	2.8	3.0	2.7	3.5	3.2	3.3
Space power/electric propulsion		8.4	3.3	2.5	2.8	2.7	2.8	2.9
Nuclear rockets		4.1	2.2	1.7	2.3	2.0	1.2	0.6
Space vehicle systems		13.3	6.6	4.3	4.5	4.4	4.3	4.2
Electronics systems		6.8	3.9	2.8	3.2	3.5	3.4	3.5
Aeronautics		9.0	5.5	4.4	4.6	5.2	6.3	7.0
Human factor systems		0.9	0.5	0.7	0.7	1.0	1.1	1.2
Chemical propulsion		3.6	1.8	1.3	1.5	1.4	1.1	1.2
Basic research		----	5.0	4.0	3.8	3.6	3.8	3.8
Subtotal	42.1	46.0	28.9	21.7	23.4	23.8	24.0	24.3
Space applications		2.8	1.5	1.5	1.3	1.3	1.5	1.8
Launch vehicle development		4.6	2.2	1.1	0.8	0.4	0.5	----
Lunar and planetary exploration		0.9	0.6	0.9	1.0	0.9	1.2	0.9
Physics and astronomy		6.0	3.8	3.9	4.1	4.0	4.2	4.2
Bioscience		0.3	0.7	0.8	0.8	0.8	0.8	0.9
Launch vehicle procurement		----	----	1.0	1.0	1.5	1.3	1.5
Subtotal	16.8	14.5	8.8	9.1	8.9	8.9	9.5	9.2
Mercury		3.4	----	----	----	----	----	----
Gemini		1.2	1.8	3.6	3.2	3.3	0.1	----
Apollo		30.1	24.6	25.8	28.2	27.6	27.6	24.5
Apollo applications		----	----	----	----	0.5	2.6	6.2
Other manned space flight		----	2.0	1.1	0.8	0.8	0.9	1.0
Subtotal	34.8	34.6	28.4	30.5	32.1	32.1	31.2	31.7
Total, all programs	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[a-c] Notes are identical to those for Table 3-24.

Source: Table 3-24.

Table 3-26. Total NASA Employment, Selected Characteristics
(June 30 approximations)

Characteristic	1960	1961	1962	1963	1964	1965	1966	1967	1968
Contractor (out-of-house) employees	36 500	57 500	115 500	218 400	347 100	376 700	360 000	272 900	211 200
NASA (in-house) employees	10 200	17 500	23 700	29 900	32 500	34 300	36 000	36 200	35 000
Total employment	46 700	75 000	139 200	248 300	379 600	411 000	396 000	309 100	246 200
Distribution of total employment									
By employer (100%)									
Contractors	78.2%	76.7%	83.0%	88.0%	91.4%	91.7%	90.9%	88.3%	88.0%
NASA	21.8	23.3	17.0	12.0	8.6	8.3	9.1	11.7	12.0
By appropriation (100%)									
Administrative operations					9.8	10.1	11.2	14.8	17.6
Research and development					72.7	77.2	77.7	78.3	79.0
Construction of facilities					17.5	12.7	11.1	6.9	3.4
By program office (100%)									
University affairs					----	----	----	1.6	----
Technology utilization					0.1	0.1	0.2	0.1	----
Tracking and data acquisition					3.9	5.5	8.0	8.1	6.4
Advanced research and technology					11.6	10.1	8.9	10.2	11.6
Space sciences and applications					15.3	15.0	13.6	14.6	12.8
Manned space flight					69.1	69.3	69.3	65.4	66.7
By sector (100%)									
Government					8.6	8.3	9.1	11.7	14.2
Industry					90.0	90.0	88.8	85.4	83.2
University and nonprofit					1.4	1.7	2.1	2.9	2.6
Other characteristics (100%)[a]									
Prime and subcontractors-R&D					57.1	61.8	58.9	58.5	63.9
Prime and subcontractors-CoF					7.2	5.7	4.9	3.1	1.5
Subtotal					64.3	67.5	63.8	61.6	65.4
Materials and supplies-R&D					14.2	13.7	12.5	10.3	12.5
Materials and supplies-CoF					10.3	7.1	6.2	3.8	1.9
Subtotal					24.5	20.7	18.7	14.1	14.4
Service contractors-R&D					----	----	4.2	6.6	----
Service contractors-AO					1.2	1.7	2.1	3.1	3.4
Subtotal					1.2	1.7	6.3	9.7	3.4
University and nonprofit-R&D[b]					1.4	1.7	2.1	2.9	2.6
NASA employees-AO					8.6	8.3	9.1	11.7	14.2

[a] Based on data from a variety of sources. See page 8 of "NASA Manpower Information Digest," January 26, 1968.

[b] Excludes JPL and MIT.

Source: "NASA Manpower Information Digest," January 26, 1968; January 23, 1967; January 25, 1966; and February 16, 1965.

Table 3-27. Scientists and Engineers Employment, Selected Characteristics
(June 30 approximations)

Characteristic[a]	1960	1961	1962	1963	1964	1965	1966	1967	1968
Contractor scientists and engineers	7 300	12 600	25 000	48 200	68 800	72 600	77 400	64 800	51 350
Percentage of contractor employment	20.0%	21.9%	21.6%	22.1%	19.8%	19.3%	21.5%	23.7%	24.3%
NASA scientists and engineers	3 500	5 800	8 200	11 000	12 400	13 500	14 300	14 500	13 715
Percentage of NASA employment	34.3%	33.1%	34.6%	36.8%	38.2%	39.4%	39.7%	40.1%	39.2%
Total scientists and engineers	10 800	18 400	33 200	59 200	81 200	86 100	91 700	79 300	65 065
Percentage of total employment	23.1%	24.5%	23.9%	23.8%	21.4%	20.9%	23.2%	25.7%	26.4%
Distribution of total S&E's									
By employer (100%)									
Contractors	67.6%	68.5%	75.3%	81.4%	84.7%	84.3%	84.4%	81.7%	78.9%
NASA	32.4	31.5	24.7	18.6	15.3	15.7	15.6	18.3	21.1
By appropriation (100%)									
Administrative operations					15.5	16.6	16.5	18.5	21.7
Research and development					82.8	81.8	82.5	81.1	78.5
Construction of facilities					1.7	1.6	1.0	0.4	0.2
By program office (100%)									
University affairs					-----	-----	-----	0.5	-----
Technology utilization					0.1	0.3	0.3	0.2	-----
Tracking and data acquisition					4.6	4.7	6.5	6.8	6.6
Advanced research and technology					14.3	12.5	10.2	11.5	13.3
Space sciences and applications					19.0	17.2	14.6	16.8	14.3
Manned space flight					62.0	65.3	68.4	64.2	65.4
By sector (100%)									
Government					15.3	15.7	15.6	18.3	21.1
Industry					81.9	81.2	81.8	78.3	77.1
University and nonprofit					2.8	3.1	2.6	3.4	1.8
Other characteristics (100%)									
Prime and subcontractors-R&D					71.8	70.7	67.2	64.8	68.2
Prime and subcontractors-CoF					1.7	1.6	0.5	0.4	0.2
Service contractors-R&D					-----	-----	5.5	5.1	-----
Service contractors-AO					0.2	0.9	0.9	0.2	0.2
Materials and supplies-R&D					8.1	7.9	7.3	5.6	8.5
University and nonprofit – R&D[b]					2.8	3.1	2.6	3.4	1.8
NASA employees-AO					15.3	15.7	15.6	18.3	21.1

[a] Based on data from a variety of sources. See page 10 of "NASA Manpower Information Digest," January 26, 1968.
[b] Excludes JPL and MIT.

Source: "NASA Manpower Information Digest," January 26, 1968. January 23, 1967; January 25, 1966; and February 16, 1965.

CHAPTER FOUR

NASA FINANCES

(Data as of 1968)

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CHAPTER FOUR

NASA FINANCES

During its first decade the National Aeronautics and Space Administration spent (obligated) just over $32 billion. This sum represented a little over three percent of the money spent by the United States Government during that period and about one half of one percent of the Nation's gross national product. The goal of this chapter is to present in tabular form some of the details making up the $32-billion figure.

The sources of financial data were numerous. Almost all of these sources were summary in nature and no attempt was made to look at the detailed documents behind them. The recently computerized SCAG (Status of Contracts and Grants) will someday prepare information like this by simply writing the proper program for it. At present, however, the press of serving management on a current day-to-day basis does not allow for a great deal of attention to be paid by NASA financial offices to reconstructing the past.

This chapter can present only a small fraction of the financial data generated during NASA's first decade. The several sources of data have not necessarily been reconciled with one another in the manner that an accountant might hope for. Rather the goal has been to give perspective to the vicissitudes (or absence thereof) of NASA's activities over a 10-year period. To indicate what has been excluded from this chapter and to point out some of the difficulties in using and comparing financial data, a brief overview of the entire budgeting and financial management processes might be helpful. The major steps in the process of financing NASA's program are these:

1. Long-range Financial Planning. (This function appears to have a very spotty history in NASA and no attempt has been made to summarize it.[1])

2. Preparing NASA's Annual Budget. This step includes the preparation of spending proposals by NASA's field installations, the aggregation and winnowing of these proposals by NASA Headquarters, the receiving of Presidential guidelines from the Bureau of the Budget, and the subsequent reconciliation of differences between NASA and the Bureau. (Little data are

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[1] See Rosholt, *Administrative History of NASA*, pp. 211-217, for a brief account of early planning for the manned lunar landing program.

available on what NASA stood ready to spend if resources had been made available. The general assumption is that agencies always want more and ask for more than they eventually get.)

3. President's Budget Submitted to Congress. The President's January budget submission to Congress publicly reveals NASA's portion of the overall national budget and constitutes the basis for subsequent congressional action. (The President's requests for NASA, hereafter referred to as NASA's budget requests, have been summarized in this chapter. The total for the agency is comparable over time but any breakdowns of the total are subject to changing definitions, as indicated in the footnotes. It should be kept in mind that the January submission is six months before the beginning of the fiscal year upon which the budget is based. Thus the FY 1968 budget was submitted to Congress in January 1967 and was for the period from July 1, 1967, through June 30, 1968.)

4. Congressional Authorization. The President's budget is primarily a request for congressional appropriations, but for certain agencies and programs it is necessary for Congress to enact a law authorizing the appropriation. This two-step process applies to NASA.[3] The authorization law is largely the product of the House and Senate Space Committees, although it may be altered on the House and Senate floors and in the House-Senate Conference Committee. (Most of the authorization legislation is summarized later in this chapter.)

5. Congressional Appropriation. It is at this point that Congress makes its chief input as to the amount of national resources allocated to NASA. The President's request may be modified at five principal points–the House Appropriations Subcommittee on Independent Offices, the House floor, the Senate Appropriations Subcommittee on Independent Offices, the Senate floor, and the compromising conference committees. It is possible that the full appropriations committees may become involved as well. (Data on NASA appropriations are presented in detail in this chapter.)

6. Bureau of the Budget Apportionment. The Bureau of the Budget establishes certain controls on the release of appropriated funds to the various agencies. (There has been no indication that this process has had an adverse affect on NASA up to 1968 and no attempt has been made to summarize it here.)

7. NASA Programming. Once NASA has obtained primary jurisdiction over the funds appropriated to it by Congress a detailed pie-cutting operation takes place. Funds are earmarked for various programs, projects, and places, setting the stage for the ongoing spending. (Constant reprogramming makes it very difficult to summarize this step and very little is done with it in this chapter. It must be recognized, however, that this is a very dynamic element in the agency's ongoing activities.)

8. Committing, Obligating, Costing, Disbursing. The flow of financial activity really requires a moving picture camera to depict it but this data

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[3] *Ibid.*, p. 60, gives the origin of this requirement.

book can present only a series of still pictures. NASA carries out most of its program by contract and whenever a contract is entered into, an appropriate amount of money is obligated to fulfill eventually the terms of the contract. At some later point the money actually changes hands and thus is disbursed or expended.

9. **Auditing.** The financial activities described above are eventually reviewed or audited both by NASA and by Congress's General Accounting Office to determine the legality of all actions and in some cases the quality of agency procedures and performance.

In summary, only a relatively small amount of financial data can be presented in this chapter. Primary emphasis will be on NASA's budget requests, congressional authorizations, and congressional appropriations—all for obtaining resources—and on obligations, for the disposition of resources. The tables can be divided into three groups. Tables 4-1 through 4-7 are summary tables providing an overview of the entire budget process. Tables 4-8 through 4-17 focus on the obtaining of resources to carry out NASA's programs. Tables 4-18 through 4-29 focus on the disposition of those resources. It will readily be noted that money is made available to NASA in rather large chunks, but is disposed of in relatively small pieces. In 9 of the 10 years covered in this chapter NASA appropriation acts were divided into three parts or "Titles," which now are termed Administrative Operations (AO), Research and Development (R&D), and Construction of Facilities (CoF). The last two are "no-year" appropriations and thus have no time limit placed on their use. Nevertheless, they are kept intact as "program year" monies, and thus during any one fiscal year, funds may be available from the current program year and several past program years. For the most part, this chapter ignores this phenomenon except for table 4-29, which attempts to articulate programmed funds, obligated funds, and disbursed funds.

In depicting the dispostion of the agency's resources, principal attention has been paid to actual obligations for each fiscal year. This probably gives the best measure of the flow of agency activity. Because disbursements lag after the event (often by several years), programmed amounts antedate the event and the ideal, accrued costs were not available for much of the 10 years covered in this chapter.

Table 4-1. NASA Appropriations by Appropriation Title and Fiscal Year
(in millions of dollars)

Fiscal Year	S&E/AO[a]	R&D[b]	C&E/CoF[c]	Total
1959[d]	86.3	196.6	48.0	330.9
1960	91.4	347.6	84.6	523.6
1961	170.8	670.4	122.8	964.0
1962	206.8	1 302.5	316.0	1 825.3
1963	----	2 897.9[e]	776.2	3 674.1
1964	494.0	3 926.0	680.0	5 100.0
1965	623.5	4 363.6	262.9	5 250.0
1966	584.0	4 531.0	60.0	5 175.0
1967	640.0	4 245.0	83.0	4 968.0
1968	628.0	3 925.0	35.9	4 588.9
Total	3524.8[f]	26 405.6[g]	2469.4	32 399.8

[a] Salaries and Expenses 1959–1962; Administrative Operations 1963–1968.

[b] Research and Development. See Note *e* below.

[c] Construction and Equipment 1959-1961; Construction of Facilities 1962–1968.

[d] See subsequent tables for FY 1959 funding pattern. Funds were appropriated to NACA, NASA, and transferred from DOD.

[e] Research, Development, and Operations (RD&O).

[f] Because of 1963 arrangement this total is understated by about $440 000 000. (See Note *e*.)

[g] Because of 1963 arrangement this total is overstated by about $440 000 000. (See Note *e*.)

Source: Tables 4–8 through 4–17 of this chapter.

Table 4-2. Adjusted Appropriations as of June 30, 1968
(in millions of dollars)

Fiscal Year	Total	S&E/AO[a]	Percentage of Total	R&D[a]	Percentage of Total	C&E/CoF[a]	Percentage of Total
1959[a]	330.9	86.3	26.1	196.6	59.4	48.0	14.5
1060	523.6	90.9	17.4	333.4	63.7	99.4	19.0
1961	964.0	166.8	17.3	671.4	69.6	125.8	13.0
1962	1 824.9	213.8	11.7	1 268.1	69.5	343.0	18.8
1963	3 673.0	440.0[b]	12.0	2 470.5[b]	67.3	762.6	20.8
1964	5 099.7	496.1	9.7	3 861.5	75.7	742.1	14.6
1965	5 249.7	623.3	11.9	4 360.1	83.1	266.4	5.1
1966	5 174.9	611.8	11.8	4 502.2	87.0	60.9	1.2
1967	4 967.6	647.5	13.0	4 235.1	85.3	85.0	1.7
1968	4 588.8	640.4	14.0	3 910.6	85.2	37.8	0.8
Total	32 397.1	4016.9[b]	12.4	25 809.5[b]	79.7	2571.0	7.9

[a] See Notes *a, b, c, d* of previous table.

[b] Adjusted appropriation for RD&O for FY 1963 as of June 30, 1968, stood at $2 910 491 027. For rough comparability $440 000 000 was moved into the AO column and thus all indicated figures are estimates.

Source: Tables 4–8 through 4–17 of this chapter.

Table 4-3. Authorizations and Appropriations Compared with Budget Requests (in millions of dollars)

	Amounts and Percentages Cut (or Added) by Congress							
	S&E/AO		R&D		C&E/CoF		Total	
Action	$	%	$	%	$	%	$	%
FY 1959								
Auth.	0	0	0	0	(3.7)	(3.8)	(3.7)	(0.9)
Appr.	4.5	5.0	41.0	17.3	50.3	51.2	95.8	22.5
FY 1960								
Auth.	0	0	12.2	3.5	5.8	8.5	18.0	3.5
Appr.	3.0	3.2	(2.3)	(0.7)	(16.0)	(23.3)	(15.3)	(3.0)
FY 1961								
Auth.	0	0	(0.4)	(0.1)	(5.0)	(4.1)	(5.4)	(0.6)
Appr.	0	0	0.6	0.1	0	0	0.6	0.1
FY 1962								
Auth.	0	0	75.0	5.4	10.0	3.0	85.0	4.4
Appr.	19.9	8.8	78.0	5.7	17.1	5.1	115.0	5.9
FY 1963								
Auth.	–	–	10.4[a]	0.4[a]	32.8	4.0	43.2	1.1
Appr.	–	–	70.4[a]	2.4[a]	42.8	5.2	113.2	3.0
FY 1964								
Auth.	42.1	7.5	232.1	5.3	87.0	10.9	361.2	6.3
Appr.	66.3	11.8	425.7	9.8	120.0	15.0	612.0	10.7
FY 1965								
Auth.	17.5	2.7	181.9	4.0	18.1	6.4	217.5	4.0
Appr.	17.5	2.7	159.4	3.5	18.1	6.4	195.0	3.6
FY 1966								
Auth.	18.4	3.0	38.9	0.9	12.3	16.5	69.6	1.3
Appr.	25.4	4.2	44.9	1.0	14.7	19.7	85.0	1.6
FY 1967								
Auth	8.0	1.2	(2.0)	(*)	5.6	5.5	11.6	0.2
Appr.	23.9	3.6	1.6	*	18.5	18.2	44.0	0.9
FY 1968								
Auth.	23.1	3.4	204.4	4.7	6.7	8.7	234.2	4.6
Appr.	43.3	6.5	427.0	9.8	40.8	53.2	511.1	10.0
Total								
Auth.	109.1	2.9	752.5	2.7	169.6	6.1	1031.2	3.0
Appr.	203.8	5.5	1246.3	4.5	306.3	11.0	1756.4	5.1

[a] Research, Development, and Operations.

* = Less than $50 000, and less than 0.1 percent.

Source: Tables 4-4 through 4-7.

Table 4-4. Requests, Authorizations, Appropriations, Obligations, and Disbursements–All Appropriations
(in millions of dollars)

Fiscal Year	Budget Request	Authorization	Appropriation	Obligations[a]	Expenditures[a]
1959	146.6	146.6	146.6		
1959	280.0[b]	259.2[c]	184.3[d]	298.7	145.5
1960	508.3	490.3	523.6[e]	487.0	401.0
1961	964.6	970.0	964.0	908.3	744.3
1961[f]	2.7	2.7	2.7		
1962	1 940.3	1 855.3[g]	1 825.3	1 691.6	1 257.0
1963	3 787.3	3 744.1	3 674.1	3 448.4	2 552.4
1964	5 712.0	5 350.8	5 100.0	4 864.8	4 171.0
1965	5 445.0[h]	5 227.5	5 250.0[i]	5 500.7	5 092.9
1966	5 260.0	5 190.4	5 175.0	5 350.5	5 932.9
1967	5 012.0	5 000.4	4 968.0	5 011.8	5 425.7
1968	5 100.0	4 865.8	4 588.9	4 520.4	4 723.7
Total	34 158.8	33 103.1[c]	32 402.5	32 082.2	30 446.4

[a] Actual obligations and disbursements during the fiscal year.

[b] Requests for NACA/NASA amounted to $280 054 000. Requests for transfers from DOD resulted in the transfer of $146 619 532 in obligational authority to NASA.

[c] See the next three tables for the derivation of these figures.

[d] Includes $101 100 000 appropriated to NACA, $83 186 300 to NASA, and $146 619 532 transferred from DOD.

[e] $38 500 000 based on FY 1959 authorization P.L. 86-12.

[f] Unobligated balances transferred from DOD ($1 661 488 R&D; $1 070 005 CoF).

[g] Includes $71 000 000 supplemental for CoF for which existing authorization was available.

[h] Includes $141 000 000 supplemental request for FY 1964 R&D program.

[i] Includes $72 494 000 R&D supplemental against FY 1964 authorization.

Source: NASA, Office of Administration, Budget Operations Division, "Budget History, Summary All Appropriations," Jan. 18, 1968; Tables 4-8 through 4-17 of this chapter.

Table 4-5. Requests, Authorizations, Appropriations, Obligations, and Disbursements–Administrative Operations
(in millions of dollars)

Fiscal Year	Budget Request	Authorization	Appropriation	Obligations[a]	Expenditures[a]
1959	90.8[b]	90.8[c]	86.3[d]	85.0	86.7
1960	94.4	94.4	91.4	89.4	91.0
1961	170.8	170.8	170.8	166.0	159.1
1962	226.7	226.7	206.8	213.2	207.1
1963[e]	–	–	–	–	18.7
1964	560.3	518.2	494.0	493.8	415.9
1965	641.0	623.5	623.5	619.9	577.5
1966	609.4	591.0	584.0	611.2	619.4
1967	663.9	655.9	640.0	646.6	649.9
1968	671.3	648.2	628.0	639.2	651.5
Total	3728.6[f]	3619.5[f]	3524.8[f]	3564.3	3476.8

[a] Actual obligations and disbursements during the fiscal year.

[b] $80 480 000 for NACA, $10 354 000 for NASA.

[c] Actual authorization of $3 354 000. Implied authorization of $87 480 000.

[d] $78 100 000 to NACA, $8 186 300 to NASA.

[e] In FY 1963, R&D and S&E were combined as RD&O. See Table 4-12.

[f] Understated because of 1963 problem.

Source: NASA, Office of Administration, Budget Operations Division, "Budget History, Administrative Operations," Jan. 18, 1968; Tables 4-8 through 4-17 of this chapter.

Table 4–6. Requests, Authorizations, Appropriations, Obligations, and Disbursements–Research and Development
(in millions of dollars)

Fiscal Year	Budget Request	Authorization	Appropriation	Obligations[a]	Expenditures[a]
1959	237.6[b]	237.6[c]	196.6[d]	175.7	34.0
1960	345.3	333.1	347.6[e]	307.9	255.7
1961	671.0	671.4	670.4	644.1	487.0
1962	1 380.5	1 305.5	1 302.5	1 261.3	935.6
1963	2 968.3[f]	2 957.9[f]	2 897.9[f]	2 878.6	2 308.4
1964	4 351.7	4 119.6	3 926.0	3 824.4	3 317.4
1965	4 523.0[g]	4 341.1	4 363.6[h]	4 358.6	3 984.5
1966	4 575.9	4 537.0	4 531.0	4 468.9	4 741.1
1967	4 246.6	4 248.6	4 245.0	4 249.3	4 487.2
1968	4 352.0	4 147.6	3 925.0	3 881.3	3 945.1
Total	27 651.9[i]	26 899.4[i]	26 405.6[i]	26 050.1	24 496.0

[a] Actual obligations and disbursements during the fiscal year.

[b] $90 950 000 for NASA, $146 619 532 for transfer to NASA from DOD.

[c] Actual authorization of $20 750 000 for NASA, the rest is implied authorization.

[d] $50 000 000 to NASA, $146 619 532 transferred from DOD.

[e] Includes $16 675 000 based on FY 1959 authorization.

[f] Includes AO money and thus overstated.

[g] Includes $141 000 000 supplemental request for FY 1964 R&D program.

[h] Includes $72 494 000 supplemental against FY 1964 authorization.

[i] Overstated as per Note f above.

Source: NASA, Office of Administration, Budget Operations Division, "Budget History, Research and Development," Jan. 18, 1968; Tables 4–8 through 4–17 of this chapter.

Table 4-7. Requests, Authorizations, Appropriations, Obligations and Disbursements–Construction of Facilities
(in millions of dollars)

Fiscal Year	Budget Request	Authorization	Appropriation	Obligations[a]	Expenditures[a]
1959	98.3[b]	102.0[c]	48.0[d]	38.0	24.7
1960	68.6	62.8	84.6[e]	89.7	54.4
1961	122.8	127.8	122.8	98.2	98.2
1961 (DOD transfer)	1.1	1.1	1.1		
1962	333.1	323.1[f]	316.0	217.1	114.3
1963	819.0	786.2	776.2	569.8	225.3
1964	800.0	713.0	680.0	546.6	437.7
1965	281.0	262.9	262.9	522.2	530.9
1966	74.7	62.4	60.0	270.4	572.4
1967	101.5	95.9	83.0	115.9	288.6
1968	76.7	70.0	35.9	64.4	126.1
Total	2776.8	2607.2	2470.5	2532.3	2472.6

[a] Actual obligations and disbursements during the fiscal year.

[b] $26 220 000 for NACA, $72 050 000 for NASA.

[c] $29 933 000 for NACA, $72 050 000 for NASA.

[d] $23 000 000 for NACA, $25 000 000 for NASA.

[e] Includes $21 825 000 based on FY 1959 authorization.

[f] Includes $71 000 000 supplemental for which existing authorization was available.

Source: NASA, Office of Administration, Budget Operations Division, "Budget History, Construction of Facilities," Jan. 18, 1969; Tables 4-8 through 4-17 of this chapter.

Table 4-8. Funding NASA's Program for FY 1959

Action	S&E[a]	R&D[a]	C&E[a]	Total
Regular request (NACA)[b]	80 480 000		26 220 000	106 700 00
Authorization[c]	(80 480 000)[d]		29 933 000	(110 413 000)
Appropriation[e]	78 100 000		23 000 000	101 100 000
Supplemental request (NASA)[f]	7 000 000	70 200 000	47 800 000	125 000 000
Authorization[g]	(7 000 000)[h]	(70 200 000)[h]	47 800 000	(125 000 000)
Appropriation[i]	5 000 000	50 000 000	25 000 000	80 000 000
Supplemental request (NASA)[j]	3 354 000	20 750 000	24 250 000	48 354 000
Authorization[k]	3 354 000	20 750 000	24 250 000	48 354 000
Appropriation[l]	3 186 300	m	m	3 186 300
FY 1959 NOA Transfers				
From ARPA[n]		59 200 000		
From Air Force[o]		57 800 000		
From Army[p]		4 078 250		
Subtotal		121 078 250		121 078 250
Total FY 1959 NOA available	86 286 300	171 078 250	48 000 000	305 364 550
DOD unobligated balances[q]		25 541 282		25 541 282
FY 1959 funding base	86 286 300	196 619 532[r]	48 000 000	330 905 832[s]
Additional transfers:				
ARPA working fund		+8 000 000		
To prior years	-1 011 000			

[a] S&E = Salaries and Expenses; R&D = Research and Development; C&E = Construction and Equipment.

[b] Submitted in January 1958, before the Space Act was being considered. NASA was established and NACA disestablished at the end of 3 months of FY 1959.

[c] P.L. 85-617, August 8, 1958.

[d] No authorizing legislation needed.

[e] P.L. 85-844, August 28, 1958.

[f] Requested on July 30, 1958, the day after the Space Act was passed.

[g] P.L. 85-657, August 14, 1958.

[h] No authorization needed because of blanket authorization in Section 307 of the Space Act, P.L. 85-568.

[i] P.L. 85-766, August 27, 1958.

[j] Requested in January 1960.

[k] P.L. 86-12, April 22, 1959.

[l] P.L. 86-30, May 20, 1959, a Government-wide pay increase.

[m] See the next table for the disposition of the R&D and C&E requests.

[n] Based on Executive Order 10783. The $59 200 000 excludes an $8 000 000 working fund (see Note *r* below).

[o] Based on EO 10783.

[p] Based on EO 10793. Consists of NOA associated with the Jet Propulsion Laboratory, transferred from the Army to NASA in December 1958.

[q] Based on EO 10783. Consists of prior years unobligated balances associated with the U.S. Scientific Satellite Project (Project Vanguard).

[r] Consists of $50 000 000 in appropriations directly to NASA and $146 619 532 in appropriations transferred from DOD.

[s] Consists of $101 100 000 appropriated to NACA, $83 186 300 appropriated to NASA, and $146 619 532 transferred from DOD.

Source: Rosholt, *Administrative History of NASA*, pp. 58-59, 85-88; NASA, Office of Administration, Budget Operations Division, *Chronological History, Fiscal Year 1959 Budget Submission* (Washington, D.C.: NASA, undated).

Table 4-9. Funding NASA's Program for FY 1960

Action	S&E[a]	R&D[a]	C&E[a]	Total
Regular request[b]	94 430 000	333 070 000	57 800 000	485 300 000
Authorization[c]	94 430 000	333 070 000	62 800 000[d]	490 300 000
Appropriation[e]	91 400 000	335 350 000[f]	73 825 000[g]	500 575 000[h]
Supplemental request[i]		12 200 000	10 800 000	23 000 000
Authorization		[j]	[j]	[j]
Appropriation[k]		12 200 000	10 800 000	23 000 000
Later transfers[l]				
From S&E to R&D	− 550 000	+ 550 000		
From R&D to C&E		− 14 730 366	+ 14 730 366	
Adjusted appropriations	90 850 000	333 369 634	99 355 366	523 575 000

[a] S&E = Salaries and Expenses; R&D = Research and Development; C&E = Construction and Equipment.

[b] Jan. 19, 1959.

[c] P.L. 86–45, June 15, 1959. P.L. 86–45 extended the need for annual authorizations indefinitely. This had originally been a one-year rider to the FY 1959 appropriation (P.L. 87–766).

[d] Includes an implied authorization of $5 000 000 for "unforeseen" contingencies.

[e] P.L. 86–213, Sept. 1, 1959.

[f] $16 675 000 based on FY 1959 authorization.

[g] $21 825 000 based on FY 1959 authorization.

[h] $38 500 000 based on FY 1959 authorization, P.L. 86–12.

[i] January 1960.

[j] P.L. 86–213 had provided excess authorization of $23 225 000.

[k] P.L. 86–425, April 14, 1960.

[l] Based upon provisions in NASA's authorization and appropriation acts. Figures as of June 30, 1968.

Source: Rosholt, *Administrative History of NASA*, pp. 85–88; [Bureau of the Budget], *The Budget of the U.S. Government, Fiscal Year 1962*, pp. 175–181; NASA, Office of Administration, Budget Operations Division, *Chronological History, Fiscal Year 1960 Budget Submission*, undated; information supplied by Budget Operations Division, NASA.

Table 4-10. Funding NASA's Program for FY 1961

Action	S&E[a]	R&D[a]	C&E[a]	Total
Regular request[b]	167 560 000	545 153 000	89 287 000	802 000 000
Budget amendment[c]	3 200 000	76 300 000	33 500 000	113 000 000
Total	170 760 000	621 453 000	122 787 000	915 000 000
Authorization[d]	170 760 000	671 453 000	127 787 000	970 000 000
Appropriation[e]	170 760 000	621 453 000	122 787 000	915 000 000
Supplemental request[f]		49 606 000		49 606 000
Authorization		[g]		[g]
Appropriation[h]		49 000 000		49 000 000
Later transfers[i]				
From S&E to R&D	−3 352 000	+3 352 000		
From S&E to C&E	−590 000		+590 000	
From R&D to C&E		−2 442 877	+2 442 877	
Adjusted appropriations	166 818 000	671 362 123	125 819 877	964 000 000
Transfers from DOD[j]		1 661 488	1 070 005	2 731 493

[a] S&E = Salaries and Expenses; R&D = Research and Development; C&E = Construction and Equipment.

[b] Jan. 18, 1960.

[c] Feb. 8, 1960. The February 1960 budget amendment stemmed primarily from the transfer of the Saturn project from the Army to NASA.

[d] P.L. 86-481, June 1, 1960 (the increase stemmed from the work of Senate Leader Lyndon Johnson).

[e] P.L. 86-626, July 12, 1960.

[f] Jan. 18, 1961.

[g] P.L. 86-481 provided excess authorization of $55 000 000.

[h] P.L. 87-14, March 31, 1961.

[i] Based on provisions of public law. Figures as of June 30, 1968.

[j] Prior year unobligated balances transferred from ARPA-DOD (42 U.S.C. 2453).

Source: Rosholt, *Administrative History of NASA*, pp. 136-138; [Bureau of the Budget], *The Budget of the U.S. Government, Fiscal Year 1963*, Appendix, pp. 745-751; NASA, Office of Administration, Budget Operations Division, *Chronological History, Fiscal Year 1961 Budget Submission*, undated; information supplied by Budget Operations Division, NASA.

Table 4-11. Funding NASA's Program for FY 1962

Action	S&E[a]	R&D[a]	CoF[a]	Total
Regular request[b]	189 986 000	819 819 000	99 825 000	1 109 730 000
Budget amendment[c]	6 700 000	99 720 000	19 250 000	125 670 000
Budget amendment[d]	30 000 000	376 000 000	143 000 000	549 000 000
Total	226 686 000	1 295 539 000	262 075 000	1 784 300 000
Authorization[e]	226 686 000	1 305 539 000	252 075 000	1 784 300 000
Appropriation[f]	206 750 000	1 220 000 000	245 000 000	1 671 750 000
Supplemental appropriation[g]	+ 10 000 000	− 10 000 000		
Supplemental request[h]		85 000 000	71 000 000	156 000 000
Authorization		i	(71 000 000)[i]	(71 000 000)[i]
Appropriation[j]		82 500 000	71 000 000	153 500 000
Later transfers[k]				
From S&E to R&D	− 660 000	+ 660 000		
From S&E to CoF	− 2 000 000		+ 2 000 000	
From R&D to CoF		− 25 040 864	+ 25 040 864	
From S&E to GSA	− 320 000			− 320 000
Adjusted appropriations	213 770 000	1 268 119 136	343 040 864	1 824 930 000

[a] S&E = Salaries and Expenses; R&D = Research and Development; CoF = Construction of Facilities.

[b] January 1961 Eisenhower budget.

[c] March 1961 amendment.

[d] May 26, 1961, amendment associated with the accelerated manned lunar landing program.

[e] P.L. 87-98, July 21, 1961.

[f] P.L. 87-141, Aug. 17, 1961.

[g] P.L. 87-332, Sept. 30, 1961.

[h] Feb. 7, 1962.

[i] P.L. 87-98 provided excess authorizations of $113 550 000. P.L. 87-584, Aug. 14, 1962, amended P.L. 87-98 to authorize explicitly the land acquisitions for which the CoF supplemental was sought.

[j] P.L. 87-545, July 25, 1962.

[k] Based on provisions of public law. Figures as of June 30, 1968.

Source: Rosholt, *Administrative History of NASA*, pp. 193-196, 233-234, 285; [Bureau of the Budget], *The Budget of the U.S. Government, Fiscal Year 1964*, Appendix, pp. 781-787, NASA, Office of Administration, Budget Operations Division, *Chronological History, Fiscal Year 1962 Budget Submission*, undated; information supplied by NASA, Budget Operations Division.

Table 4-12. Funding NASA's Program for FY 1963

Action	RD&O[a]	CoF[b]	Total
Regular request	2 968 278 000	818 998 000	3 787 276 000
Authorization[c]	2 957 878 000	786 237 250	3 744 115 250
Appropriation[d]	2 897 878 000	776 237 000	3 674 115 000
Later transfers[e]			
From CoF to RD&O	+ 13 686 750	− 13 686 750	
From RD&O to GSA	− 1 073 723		− 1 073 723
Adjusted appropriations	2 910 491 027	762 550 250	3 673 041 277

[a] RD&O = Research, Development, and Operations. The amalgamation of R&D and S&E into RD&O greatly complicates year to year comparisons. In FY 1964 RD&O is split into R&D and AO. AO becomes roughly comparable to S&E. For FY 1963 AO can be roughly set at about $440 million.

[b] CoF = Construction of Facilities.

[c] P.L. 87-584, Aug. 14, 1962.

[d] P.L. 87-741, Oct. 3, 1962.

[e] Based on provisions of public law. Figures as of June 30, 1968.

Source: Rosholt, *Administrative History of NASA*, pp. 284-285; [Bureau of the Budget], *The Budget of the U.S. Government, Fiscal Year 1965*, Appendix, pp. 765-772; NASA, Office of Administration, Budget Operations Division, *Chronological History, Fiscal Year 1963 Budget Submission*, undated; information supplied by NASA, Budget Operations Division.

Table 4-13. Funding NASA's Program for FY 1964

Action	AO[a]	R&D[a]	CoF[a]	Total
Regular request[b]	(560 300 000)	(4 351 700 000)	800 000 000	5 712 000 000
Authorization[c]	518 185 000	4 119 575 000	713 060 400	5 350 820 400
Appropriation[d]	494 000 000	3 926 000 000	680 000 000	5 100 000 000
Later transfers[e]				
From AO to CoF	-13 300 000		+13 300 000	
From R&D to AO	+15 685 000	-15 685 000		
From R&D to CoF		-48 845 300	+48 845 300	
From AO to GSA	-285 956			-285 956
Adjusted appropriations	496 099 044	3 861 469 700	742 145 300	5 099 714 044

[a] AO = Administrative Operations; R&D = Research and Development; CoF = Construction of Facilities.

[b] In the budget request AO and R&D were submitted as one account, RD&O.

[c] P.L. 88-113, Sept. 6, 1963 P.L. 88-215, Dec. 19, 1963.

[d] Based on provisions of public law. Figures as of June 30, 1968.

Source: Rosholt, *Administrative History of NASA*, pp. 285-289; *The Budget of the U.S. Government, Fiscal Year 1966*, Appendix, pp. 845-851; NASA, Office of Administration, Budget Operations Division, *Chronological History, Fiscal Year 1964 Budget Submission*, Nov. 26, 1963; information supplied by NASA, Budget Operations Division.

Table 4-14. Funding NASA's Program for FY 1965

Action	AO	R&D	CoF	Total
Supplemental request[a]		141 000 000		141 000 000
Regular request	641 000 000	4 382 000 000	281 000 000	5 304 000 000
Authorization[b]	623 525 500	4 341 000 000	262 880 500	5 227 506 000
Appropriation[c]	623 525 500	4 363 594 000[d]	262 880 500	5 250 000 000[d]
Later transfers[e]				
From R&D to CoF		-3 496 993	+3 496 993	
From AO to GSA	-272 812			-272 812
Adjusted appropriations	623 252 688	4 360 097 007	266 377 493	5 249 727 188

[a] For FY 1964 Program. Note cuts in 1964 request shown in previous table.

[b] P.L. 88-369, July 11, 1964.

[c] P.L. 88-507, Aug. 30, 1964.

[d] Of this appropriation, $72 494 000 was charged against the FY 1964 authorization. This was Congress's response to the supplemental request mentioned in the first footnote.

[e] Based on provisions of public law. Figures as of June 30, 1968.

Source: *The Budget of the U.S. Government, Fiscal Year 1967*, Appendix, pp. 867-873; NASA, Office of Programming, Budget Operations Division, *Chronological History, Fiscal Year 1965 Budget Submission*, Sept. 14, 1964; information supplied by NASA, Budget Operations Division.

Table 4-15. Funding NASA's Program for FY 1966

Action	AO	R&D	CoF	Total
Regular request	609 400 000	4 575 900 000	74 700 000	5 260 000 000
Authorization[a]	591 048 850	4 536 971 000	62 376 350	5 190 396 200
Appropriation[b]	584 000 000	4 531 000 000	60 000 000	5 175 000 000
Later transfers[c]				
From R&D to AO	+ 27 896 000	− 27 896 000		
From R&D to CoF		− 940 000	+ 940 000	
From AO to GSA	− 76 000			− 76 000
Adjusted appropriations	611 820 000	4 502 164 000	60 940 000	5 174 924 000

[a] P.L. 89–53, June 28, 1965.

[b] P.L. 89–128, Aug. 16, 1965.

[c] Based on provisions of public law. Figures as of June 30, 1968.

Source: *The Budget of the U.S. Government, Fiscal Year 1968*, Appendix, pp. 873–879; NASA, Office ot Programming, Budget Operations Division, *Chronological History, Fiscal Year 1966 Budget Submission*, Sept. 19, 1965; information supplied by NASA, Budget Operations Division.

Table 4-16. Funding NASA's Program for FY 1967

Action	AO	R&D	CoF	Total
Regular budget	663 900 000	4 246 600 000	101 500 000	5 012 000 000
Authorization[a]	655 900 000	4 248 600 000	95 919 000	5 000 419 000
Appropriation[b]	640 000 000	4 245 000 000	83 000 000	4 968 000 000
Later transfers[c]				
From R&D to AO	+ 7 900 000	− 7 900 000		
From R&D to CoF		− 2 000 000	+ 2 000 000	
From AO to GSA	− 417 000			− 417 000
Adjusted appropriations	647 483 000	4 235 100 000	85 000 000	4 967 583 000

[a] P.L. 89-528, Aug. 5, 1966.

[b] P.L. 89-555, Sept. 6, 1966.

[c] Based on provisions of public law. Figures as of June 30, 1968

Source: *The Budget of the U.S. Government, Fiscal Year 1969*, Appendix, pp. 873-879; NASA, Office of Programming, Budget Operations Division, *Chronological History, Fiscal Year 1967 Budget Submission*, Sept. 12, 1966; information supplied by NASA, Budget Operations Division.

Table 4-17. Funding NASA's Program for FY 1968

Action	AO	R&D	CoF	Total
Budget request	671 300 000	4 352 000 000	76 700 000	5 100 000 000
Authorization[a]	648 206 000	4 147 565 000	69 980 000	4 865 751 000
Appropriation[b]	628 000 000	3 925 000 000	35 900 000	4 588 900 000
Later transfers[c]				
From R&D to AO	+ 12 500 000	− 12 500 000		
From R&D to CoF		− 1 900 000	+ 1 900 000	
From AO to GSA	− 127 000			− 127 000
Adjusted appropriations	640 373 000	3 910 600 000	37 800 000	4 588 773 000

[a] P.L. 90-67, Aug. 21, 1967.

[b] P.L. 90-131, Nov. 8, 1967.

[c] Based on provision of public law. Figures as of June 30, 1968.

Source: *The Budget of the U.S. Government, Fiscal Year 1969,* Appendix, pp. 873-879; NASA, Office of Programming, Budget Operations Division, *Chronological History, Fiscal Year 1968 Budget Submission*, Nov. 8, 1967; information supplied by NASA, Budget Operations Division.

Table 4-18. Direct Obligations, Actual and Comparative, by Appropriation Title
(in millions of dollars)

Appropriation Title	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
Administrative Operations, comparative[a]	86.0[b]	117.3	222.7	315.5	424.4	493.9	620.0	611.2	646.6	639.3
Research and Development, comparative[c]	174.7	280.0	587.5	1159.0	2454.2	3824.4	4358.6	4468.9	4249.3	3816.6
Construction of Facilities, comparative	38.0	89.7	98.2	217.1	569.8	546.6	522.2	270.4	115.9	64.5
Total, all appropriations	298.7	486.9	908.3	1691.7	3448.4	4864.8	5500.7	5350.5	5011.7	4520.4
Salaries and Expenses, actual	85.0	89.4	166.0	213.2	---	---	---	---	---	---
Administrative Operations, actual	---	---	---	---	---	493.9	620.0	611.2	646.6	639.3
Research and Development, actual	175.7	307.9	644.2	1261.3	---	3824.4	4358.6	4468.9	4249.3	3816.6
Research, Development and Operations, actual	---	---	---	---	2878.6	---	---	---	---	---
Construction and Equipment, actual	38.0	89.7	98.2	---	---	---	---	---	---	---
Construction of Facilities, actual	---	---	---	217.1	569.8	546.6	522.2	270.4	115.9	64.5
Total, all appropriations	298.7	486.9	908.3	1691.7	3448.4	4864.8	5500.7	5350.5	5011.7	4520.4
Percentages of yearly total										
Administrative Operations, comparative	28.8%	24.1%	24.5%	18.6%	12.3%	10.2%	11.3%	11.4%	12.9%	14.1%
Research and Development, comparative	58.5	57.5	64.7	68.5	71.2	78.6	79.2	83.5	84.8	84.5
Construction of Facilities, comparative	12.7	18.4	10.8	12.8	16.5	11.2	9.5	5.1	2.3	1.4
Total, all appropriations (100%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Percentages of Ten-Year Total										
Administrative Operations, comparative	11.1%									
Research and Development, comparative	81.0									
Construction of Facilities, comparative	7.9									
Total, all appropriations (dollars)	32 082.2									

[a] Calculated by adding "R&D Support of Plant" to "Salaries and Expenses" for 1959–1962. Figures for 1963 based on data from *History of Budget Plans . . . Fiscal Years 1959 Through 1963* (see Source, below).

[b] Includes $1 011 781 made in FY 1958 for FY 1959 program.

[c] Calculated by subtracting "R&D Support of Plant" from "Research and Development, actual." Figures used for "R&D Support of Plant" were: $1.0 million for 1959, $27.9 million for 1960, $56.7 million for 1961, and $102.3 million for 1962. Figures for 1963 based on *History of Budget Plans . . . Fiscal Years 1959 Through 1963.*

Source: NASA, Office of Programming, Budget Operations Division, *History of Budget Plans, Actual Obligations, and Actual Expenditures for Fiscal Years 1959 Through 1963* (Washington, D.C.: NASA, February 1965); an untitled draft History of Budget Plans . . . Fiscal Years 1964–1966. NASA, Office of Administration, Budget Operations Division, "Budget History, Summary All Appropriations," Jan. 18, 1968; "Budget History, Administrative Operations," Jan. 18, 1968; "Budget History, Research and Development," Jan. 18, 1968; "Budget History, Construction of Facilities," Jan. 18, 1968.

Table 4-19. Administrative Operations Direct Obligations, by Installation
(in millions of dollars)

Installation	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
NASA Headquarters	5.5	8.5	13.9	25.9	46.3	45.6	51.5	54.1	57.0	55.4
WSO, NEO, PLOO, NAPO[a]	---	.5	5.7	1.5	3.7	5.3	23.3	5.8	3.6	2.7
Langley Research Center	30.7	32.8	39.1	46.6	51.0	52.1	59.0	63.5	64.3	62.2
Ames Research Center	16.0	17.7	19.9	22.9	25.4	29.9	31.8	33.2	33.8	33.8
Lewis Research Center	27.5	31.2	35.8	45.2	53.6	61.5	68.5	66.4	66.3	66.2
Flight Research Center	3.2	4.0	5.1	7.2	7.4	9.4	10.5	9.4	9.5	9.5
Electronics Research Center	---	---	---	--	---	1.1	3.2	6.4	12.2	15.4
Space Nuclear Propulsion Office	---	---	---	.3	1.0	1.5	1.7	1.8	2.0	2.0
Goddard Space Flight Center	1.8	15.0	20.4	39.1	52.7	61.6	92.6	64.4	71.1	68.3
Wallops Station	1.3	2.6	5.0	7.1	7.2	8.7	10.9	9.3	9.7	8.8
Marshall Space Flight Center	---	5.0	68.6	89.2	111.3	123.5	137.8	128.4	128.7	126.2
Manned Spacecraft Center	---	--	9.2	24.1	46.6	64.4	88.5	86.5	95.7	95.7
Kennedy Space Center	---	---	---	6.4	18.2	29.3	40.7	82.0	92.7	93.1
Total Administrative Operations	86.0	117.3	222.7	315.5	424.4	493.9	620.0	611.2	646.6	639.2
1959-1962 Support of Plant	1.0	27.9	56.7	102.3						
1959-1962 Salaries and Expenses	85.0	89.4	166.0	213.2						

[a] Western Support Office, North Eastern Office, Pacific Launch Operations Office, NASA Pasadena Office.

Source: NASA, Office of Programming, Budget Operations Division, *History of Budget. . .1959 Through 1963*; draft History of Budget. . .1964-1966; information supplied by NASA, Budget Operations Division.

Table 4-20. Amounts Programmed for Administrative Operations (1968 only), by NASA Installation (in millions of dollars)[a]

Installation	Personal Services	Travel	Operation of Installation	Total[b]
NASA Headquarters	34.1	2.2	21.8	58.1
Western Support Office[c]	.7	*	.3	1.0
NASA Pasadena Office	1.3	.1	.5	1.9
Langley Research Center	48.5	1.0	12.8	62.3
Ames Research Center	26.7	.7	6.3	33.7
Lewis Research Center	54.7	1.0	10.6	66.3
Flight Research Center	3.8	.2	2.7	6.7
Electronics Research Center	10.0	.3	5.1	15.4
Space Nuclear Propulsion Office–Cleveland	1.0	.1	*	1.1
Space Nuclear Propulsion Office–Nevada	.5	*	*	.5
Space Nuclear Propulsion Office–W (Headquarters)[d]	.4	.1	0	.5
Goddard Space Flight Center	37.1	2.2	16.6	55.9
Wallops Station	8.5	.1	3.6	12.2
Jet Propulsion Laboratory	0	0	.1	.1
Marshall Space Flight Center	89.7	2.8	33.7	126.2
Manned Spacecraft Center	33.4	4.0	28.6	66.0
Kennedy Space Center	36.9	.7	55.5	93.1
NASA total	387.2	15.4	198.1	600.6

[a] An asterisk indicates less than $50 000.
[b] Sum of the rounded figures in the first three columns except in the NASA total.
[c] Discontinued March 1, 1968.
[d] Includes SNPO-Albuquerque.

Source: NASA, Financial Management Division, *Financial Status of Programs: Administrative Operations* (Washington, D.C.: June 30, 1968).

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Table 4–21. Research and Development Direct Obligations, by Budget Line Item (Program)
(in millions of dollars)[a]

Budget Line Item[b]	Number	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total[c]
Sustaining university program	41	–	–	–	10.1	24.7	35.9	45.7	45.2	31.0	11.5	214.8
Special support	50	–	–	–	–	–	–	–	–	3.5	2.3	5.7
Tracking and data acquisition	51	2.2	13.7	23.7	65.4	108.0	148.8	259.7	264.2	260.6	264.0	1 408.9
Space applications	61	3.7	8.0	28.3	75.2	93.2	84.1	69.0	79.2	75.8	90.5	560.3
Technology utilization	65	–	–	–	–	2.0	3.2	4.3	3.5	5.4	2.3	20.6
OART Apollo Applications experiments	7A	–	–	–	–	–	–	–	–	.7	.3	1.0
Mission analysis program	70	–	–	–	–	–	–	–	1.4	2.6	1.5	5.5
Space power and electric propulsion systems	71	.4	1.0	4.8	26.6	39.8	42.6	38.5	29.1	49.4	42.7	268.2
Nuclear rockets	72	1.5	3.0	9.1	25.9	67.6	78.7	58.1	57.1	53.5	41.6	396.4
Chemical and solar power	73	–	1.1	5.2	4.8	7.8	12.5	15.2	13.2	1.2	*	62.3
Space vehicle systems	74	–	2.4	1.5	12.2	40.8	42.7	46.0	33.3	35.9	33.4	238.4
Electronics systems	75	–	2.4	2.9	2.5	15.5	24.7	28.0	32.5	33.7	37.1	181.4
Aeronautics	76	2.0	4.7	1.3	.2	16.7	17.0	36.1	28.5	52.9	65.9	217.9
Human factor systems	77	–	–	.5	3.3	8.8	11.4	15.6	14.6	16.7	17.8	89.1
Chemical propulsion	78	6.2	3.5	1.1	22.6	47.8	46.3	60.4	38.6	46.7	30.8	293.3
Basic research program	79	–	–	2.2	7.4	17.0	21.2	22.5	21.9	21.8	2.1	135.6
Voyager	82	–	–	–	–	–	–	6.7	16.8	10.0	3.1	36.6
Launch vehicle development	83	22.5	50.7	79.2	81.6	98.7	108.5	91.9	51.5	29.8	.1	614.6
Lunar and planetary exploration	84	15.6	23.7	88.5	166.9	223.1	182.7	184.0	201.2	172.9	147.2	1 304.8
Physics and astronomy	85	27.6	14.3	44.6	88.2	148.6	146.0	160.1	141.1	134.3	145.3	1 049.7
Manned space sciences	86	–	–	–	–	–	1.5	7.8	11.4	18.4	3.6	42.3
Bioscience	87	–	–	3.1	2.2	10.1	21.1	29.7	35.5	41.2	42.0	186.1
OSS&A vehicles procurement[d]	89	–	–	–	–	8.6	127.3	148.9	170.4	140.8	133.7	974.0
Gemini	91	–	–	–	55.0	287.6	419.2	308.3	163.5	48.0	.7	1 283.2
Apollo	92	10.1	36.1	190.3	446.5	1160.6	2225.0	2708.9	2971.3	2877.9	2535.2	15 169.3
Advanced manned missions	93	–	–	–	–	10.1	13.9	20.3	13.4	8.4	1.9	67.9
Apollo Applications	96	–	–	–	–	–	–	–	13.8	83.4	122.2	219.3
Completed missions	99	43.0	91.3	91.6	55.4	12.0	-.1	-6.3	-.1	.1	-*	295.8
Various early projects[e]	NN	39.9	24.2	9.7	7.0	5.2						
Totals		174.7	280.1	587.6	1159.0	2454.3	3814.7	4359.4	4452.1	4256.6	3778.8	25 343.0

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Table 4-21. Research and Development Direct Obligations, by Budget Line Item (Program) (Continued)
(in millions of dollars)[a]

Budget Line Item[b]	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total[c]
Program office percentage of total											
Aircraft research and technology (76)	1.1%	1.7%	0.2%	*	0.7%	0.4%	0.8%	0.6%	1.2%	1.7%	0.9%
Space research and technology (7A-75, 77-79)	4.6	4.8	4.7	9.1	10.0	7.4	6.5	5.5	6.2	5.5	6.6
(Office of Advanced Research and Technology)	(5.7)	(6.5)	(4.9)	(9.1)	(10.7)	(7.8)	(7.3)	(6.1)	(7.4)	(7.2)	(7.5)
Scientific investigations in space (82-89)	37.6	31.7	36.7	29.2	19.9	15.4	14.4	14.1	12.9	12.6	16.6
Space applications (61)	2.1	2.9	4.8	6.5	3.8	2.2	1.6	1.8	1.8	2.4	2.2
(Office of Space Science and Applications)	(39.7)	(34.6)	(41.5)	(35.7)	(23.7)	(17.6)	(16.0)	(15.9)	(14.7)	(15.0)	(18.8)
Manned Space Flight, Office of (91-99)	30.4	45.5	48.0	48.1	59.9	69.7	69.5	71.0	70.9	70.4	67.2
Tracking and Data Acquisition, Office of (51)	1.3	4.9	4.0	5.6	4.4	3.9	6.0	5.9	6.1	7.0	5.6
Other (41, 50, 65)	.0	.0	.0	.9	1.1	1.0	1.1	1.1	.9	.4	1.0
Various early projects (NN)[f]	22.8	8.6	1.7	.6	.2						
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

[a] For Tables 4-21, 4-22, and 4-23, a line has been drawn between the 1959-1963 period and the 1964-1968 period to indicate an occasional lack of continuity between the two periods. This lack of continuity has three principal causes. First, the 1959-1963 period included vehicle procurement costs with the space flight project (see note d below). Second, the coding/accounting structure was in a state of development until about 1963 and it has been difficult to reconstruct the early years. Third, there is a paucity of information from the early years and some of the early projects had to be handled somewhat arbitrarily. The discrepancies between the two periods can be calculated by subtracting years 1964-1968 from the total and comparing it with a total calculated for 1959-1963. An asterisk indicates less than $50 000.

[b] Nomenclature based on Changes 9 and 10 of FMM 9100, i.e., 1968 nomenclature.

[c] Total is what is shown on the current accounts of the agency. Footnote a explains why annual amounts may not add to the Total.

[d] As explained in footnote a the data for the 1959-1963 period includes vehicle procurement costs in the space flight project amounts.

[e] The amounts on this line are buried somewhere in the totals for other programs.

[f] The amounts upon which these percentages are based are included in the totals for other program areas.

Source: NASA, Office of Programming, Budget Operations Division, *History of Budget... 1959 Through 1963*; draft History of Budget...1964-1966; NASA, Financial Management Division, *Financial Status of Programs: Research and Development* (Washington, D.C.: NASA, June 30, 1968); NASA, *Financial Management Manual*, FMM 9100, Changes 9 and 10 (Washington, D.C.: NASA, undated).

Table 4-22. Research and Development Direct Obligations, by Budget Line Item and Unique Project Number (in millions of dollars)[a]

Budget Line Item/Unique Project[b]	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total[c]
41 Sustaining university program				10.1	24.7	35.9	45.7	45.2	31.0	11.5	214.8
181 Training grants				1.4	13.9	19.8	24.5	25.8	15.2	2.4	103.7
182 Facilities grants				6.4	6.9	9.1	8.2	7.0	4.9	.6	43.2
183 Research grants				2.4	3.9	7.6	12.3	12.4	10.9	8.6	67.7
184 Socio-economic studies						.2	---	---	---	--	.2
50 Special support						---	---	---	3.5	2.3	5.7
380 Special support (OSS&A)						---	---	---	3.5	2.3	5.7
51 Tracking and data acquisition	2.2	13.7	23.7	65.4	108.0	148.8	259.7	264.2	260.6	264.0	1 408.9
150 Tracking and data acquisition SRT	.3	3.7	7.0	14.6	12.4	10.6	15.1	13.3	13.0	11.4	106.4
311 Network operations	2.0	10.0	11.0	44.0	51.4	68.0	96.7	135.3	184.6	203.4	803.3
312 Equipment and components			5.7	6.9	44.2	70.2	147.9	115.6	62.6	49.2	498.9
581 Advanced studies						---	--	---	.3	---	.3
61 Space applications	3.7	8.0	28.3	75.2	93.2	84.6	69.0	79.2	75.8	90.5	560.3
160 Space applications SRT	.1	1.9	3.5	4.1	4.3	6.9	6.5	7.6	7.0	17.7	58.5
164 Communications and navigation SRT		.8	1.3	4.9	7.7	3.5	1.0	1.7	3.9	.6	26.7
165 Future applications SRT						.2	-•	---	---	---	.6
166 Applications technology SRT						.5	1.3	1.2	.5	---	3.6
601 Tiros/TOS improvements	.6	2.6	3.4	6.3	19.3	7.5	5.6	1.3	3.8	10.0	52.4
602 Tiros Operational System (TOS)						---	---	---	---	•	•
603 Meteorological flight experiments						---	.6	4.1	5.4	.2	10.4
604 Nimbus A-D		.9	6.9	23.4	30.8	40.8	15.0	24.7	24.4	33.2	190.3
607 Meteorological soundings				.4	1.0	2.3	2.6	2.6	2.6	3.3	14.9
609 Systems A (automatic picture taking. . .)						•	---	---	---	---	.3
610 International Applications Satellite						---	---	---	.1	.1	.2
621 *Echo I* (nonrigid) A-11	3.0	1.4	2.1	1.6	-•	.8	---	-•	---	---	1.4
622 Echo A-12 (includes AVT)			2.0	8.3	2.4	1.6	.3	.1	.2	-•	8.3
624 Rebound			.2	.1		---	---	---	---	---	1.1
625 Radiation measurements		.4	.6	1.2	-.4	•	---	--	-•	---	1.7
626 Relay			7.0	15.3	13.2	5.9	.7	.1	•	-•	33.7
627 Syncom			1.3	9.6	14.9	3.8	.4	-.2	-•	-.2	21.0
630 Applications Technology Satellites (A-E)						10.2	28.6	31.4	24.6	21.5	116.2
632 Early Gravity Gradient Test Satellite						---	3.1	.5	-.1	---	3.5
635 Applications Technology Satellites (F-G)						--	---	---	---	.8	.8
682 Advanced studies-space applications						---	---	.4	.3	.4	1.1
855 Geodetic Satellites						.6	3.4	3.8	3.3	3.1	13.7

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Table 4-22. Research and Development Direct Obligations, by Budget Line Item and Unique Project Number (Continued)
(in millions of dollars)[a]

Budget Line Item/Unique Project[b]	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total[c]
65 Technology utilization					2.0	3.2	4.3	3.5	5.4	2.3	20.6
141 Identification and dissemination					.9	2.6	2.9	2.7	4.6	1.8	15.5
143 Economic studies					1.1	.6	1.4	.8	.7	.5	5.1
7A (20) OART Apollo Applications experiments						---	---	---	.7	.3	1.0
740 OART experiment definition						---	---	---	.7	.3	1.0
70 Mission analysis program						---	---	1.4	2.6	1.5	5.5
130 Mission analysis SRT						---	---	.4	1.1	1.5	3.0
789 Advanced studies–mission analysis						---	---	1.0	1.6	-*	2.5
71 Space power and electric propulsion systems	.4	1.0	4.8	26.6	39.8	42.6	38.5	29.1	49.4	42.7	268.2
120 Space power and electric propulsion. . .SRT	.1	.4	4.2	15.3	19.4	23.3	25.4	22.8	34.7	33.8	174.0
701 SNAP-8 development project	.3	.6	.6	7.9	16.0	15.4	11.1	5.8	11.6	7.5	77.6
704 SERT (Space Electric Rocket Test)			*	3.4	3.2	3.5	2.0	.4	2.9	1.4	14.8
705 Small nuclear electric. . .flight projects					1.2	.3	*	-*	-*	---	1.5
780 Advanced studies–nuclear electric systems						.2	---	.1	-*	---	.3
72 Nuclear rockets	1.5	3.0	9.1	25.9	67.6	78.7	58.1	57.1	53.5	41.6	396.4
121 Nuclear rocket systems SRT	.5	.4	.3		.2	.2	1.0	.6	1.8	1.2	5.1
122 Nuclear rocket propulsion SRT			*	.7	12.9	19.3	21.1	18.8	15.2	7.9	96.7
321 Nuclear rocket Dev. Station operations						.8	.7	2.0	2.3	4.0	9.8
706 RIFT (Reactor in Flight Test)			.3	1.2	10.4	7.0	.1	-*	-*	-*	18.9
717 KIWI	1.0	2.6	8.4	4.7	4.5	1.8	-1.4	.4		-*	21.0
718 Nerva				19.3	39.6	49.7	36.6	35.3	34.3	28.6	244.8
73 Chemical and solar power		1.1	5.2	4.8	7.8	12.5	15.2	13.2	1.2	*	62.3
123 Chemical and solar power SRT		1.1	5.2	4.8	7.8	12.5	15.2	13.2	1.2	*	62.3
74 Space vehicle systems		2.4	1.5	12.2	40.8	42.7	46.0	33.3	35.9	33.4	238.4
124 Space vehicle systems SRT		2.4	.4	5.3	17.1	23.3	24.5	25.0	27.5	28.9	157.4
709 Small space vehicle flight projects			1.1	.3	1.5	1.7	1.2	2.0	5.0	1.5	13.1
711 Scout reentry heating experiment				1.7	1.5	.3	.3	2.7	2.2	1.9	7.7
712 Meteoroid Satellite Project S-55b						---	---	---	---	---	.1
713 Meteoroid Satellite Project S-55c, S-55d				1.0	2.9	.3	.3	---	---	-*	1.8
714 FIRE				4.0	13.9	6.1	2.6	.1	.1	-*	20.3
725 Pegasus					4.0	9.9	13.7	1.5	.1	*	29.1
727 Lifting-body flight program						1.2	.8	1.5	1.0	1.1	5.7
784 Advanced studies–space vehicle systems						.2	2.5	.5	*	-*	3.2

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Table 4-22. Research and Development Direct Obligations, by Budget Line Item and Unique Project Number (Continued)
(in millions of dollars)[a]

Budget Line Item/Unique Project[b]	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total[c]
75 Electronics systems		2.4	2.9	2.5	15.5	24.7	28.0	32.5	33.7	37.1	181.4
125 Electronics systems SRT		2.4	2.9	2.5	14.1	22.3	25.6	29.9	32.3	36.6	170.7
715 Small electronics systems flight projects					1.4	2.4	1.6	1.1	.4	-*	6.7
730 RAM-C (Radio Attenuation Measurements)						---	.9	1.3	1.0	.5	3.6
785 Advanced studies-electronics						---	---	.2	---	---	.4
76 Aeronautics	2.0	4.7	1.3	.2	16.7	17.0	36.1	28.5	52.9	65.9	217.9
126 Aeronautics SRT	2.0	4.7	1.3	.1	6.0	7.7	8.2	11.0	10.3	18.8	62.7
719 X-15 research aircraft					5.6	.8	1.4	.9	.8	3.5	13.0
720 Supersonic aircraft technology				.1	4.3	5.9	21.2	11.8	13.7	12.5	69.6
721 *V/STOL* aircraft technology					.9	2.6	2.2	3.0	5.8	7.0	21.5
729 Hypersonic ramjet experiment						---	2.3	1.1	6.3	7.0	16.7
732 XB-70 flight research program						---	---	.2	11.6	10.0	21.9
733 Aircraft noise alleviation						---	---	--	4.4	7.1	11.4
786 Advanced studies-Aeronautical Systems						---	.7	.4	*	---	1.1
77 Human factor systems			.5	3.3	8.8	11.4	15.6	14.6	16.7	17.8	89.1
127 Human factor systems SRT			.5	2.9	8.7	11.5	14.6	12.6	15.1	16.5	82.8
708 Small biotechnology flights				.4	.1	*	.9	2.0	1.6	.8	5.8
735 Orbiting Frog Otolith (*Ofo*)						---	---	---	---	.5	.5
78 Chemical propulsion	6.2	3.5	1.1	22.6	47.8	46.3	60.4	38.6	46.7	30.8	293.3
128 Chemical propulsion SRT	6.2	3.5	1.1	5.9	12.6	22.1	17.2	13.5	18.6	15.5	105.8
710 Small chemical propulsion flight projects					.3	*	*	---	*	---	.4
726 M-1 engine development				16.7	34.9	24.2	20.9	3.5	2.8	-.2	102.5
728 Large solid motor program (S-10)						---	15.6	8.7	8.5	1.6	34.5
731 Chemical rocket experimental engineering						---	6.7	12.9	16.7	13.8	50.2
79 Basic research program			2.2	7.4	17.0	21.2	22.5	21.9	21.8	2.1	135.6
129 Research program SRT			2.2	7.4	17.0	21.2	22.5	21.9	21.8	2.1	135.6
82 Voyager						---	6.7	16.8	10.0	3.1	36.6
818 Voyager						---	6.7	16.8	10.0	3.1	36.6
83 Launch vehicle development	22.5	50.7	79.2	81.6	98.7	108.5	91.9	51.5	29.8	.1	614.6
839 FLOX (fluorine-oxygen) development						*	3.7	.5	.2	---	4.5
890 Scout development	5.5	2.9	7.8	4.4	4.7	-*	.3	*	-*	-*	25.5
891 Centaur development	4.0	36.5	62.2	71.8	90.3	108.3	87.9	52.0	29.6	.1	543.3
892 Delta development	13.1	11.3	9.3	5.3	3.7	.2	-*	-1.0	-*	---	41.4

Table 4-22. Research and Development Direct Obligations, by Budget Line Item and Unique Project Number (Continued)
(in millions of dollars)[a]

Budget Line Item/Unique Project[b]	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total[c]
84 Lunar and planetary exploration	15.6	23.7	88.5	166.9	223.1	182.7	184.0	201.2	172.9	149.2	1 304.8
185 Lunar and planetary exploration SRT-Science		2.6	1.0	12.7	12.4	9.9	12.6	13.6	13.5	10.5	136.8
186 Lunar and planetary exploration SRT-ATD	12.2	9.5	19.4	4.2	5.8	3.6	8.8	6.8	7.2	7.2	56.3
187 Lunar and planetary exploration SRT-SS					2.9	1.3	-.7	---	-*	---	2.6
194 Planetary extension program SRT						---	---	---	---	10.6	10.6
684 Advanced studies–lunar and planetary				.4	1.2	1.5	2.2	1.7	2.0	1.2	10.2
801 Ranger	3.4	11.7	52.3	62.6	89.4	30.2	12.5	-.5	-.4	-.3	169.8
803 Surveyor			4.8	38.1	66.3	70.4	82.7	106.0	80.3	33.0	468.5
804 Surveyor Orbiter						*	-.1	---	-*	---	1.1
806 Mariner A			11.0	-4.0		2.0	-.4	---	-*	-*	19.9
807 Mariner B				12.4	5.5	-1.0	-.6	---	---	---	19.2
808 Mariner-Mars '64					31.8	37.7	16.2	2.3	.3	-.3	83.2
810 Mariner R				39.3	7.7	.1	-.4	---	-.2	---	21.6
812 Mariner-Mars '66						7.0	1.6	-.8	-.1	---	7.7
813 Mariner IV						---	---	.3	.8	.6	1.6
814 Lunar Orbiter				1.2	*	20.0	49.5	56.8	27.2	8.9	162.3
816 Mariner-Mars '69						---	---	4.1	30.3	72.6	107.0
817 Mariner-Venus '67						---	---	10.9	12.1	3.2	26.2
85 Physics and astronomy	27.6	14.3	44.6	88.2	148.6	146.0	160.1	141.1	134.3	145.3	1 049.7
188 Physics and astronomy SRT	2.5	3.0	2.9	9.4	11.9	15.0	17.3	18.8	20.5	22.7	150.9
385 Data analysis (OSS&A)						---	---	1.6	1.9	2.5	6.0
685 Advanced studies–physics and astronomy						---	---	.4	.7	-*	1.0
811 Pioneer (IQSY)					*	15.8	15.1	9.2	10.2	5.9	56.3
821 Orbiting Solar Observatories		1.0	4.9	5.8	10.0	12.2	10.7	9.8	10.6	11.6	67.4
822 Advanced Orbiting Solar Observatories				.2	.1	7.2	6.9	10.4	-1.0	-*	23.6
831 Orbiting Astronomical Observatories		.3	11.6	32.9	39.5	35.3	31.8	22.7	28.0	45.8	242.9
841 Orbiting Geophysical Observatories		.3	8.6	18.4	42.2	32.4	40.1	28.6	24.9	20.7	204.8
851 Energetic Particles Explorers		.6	1.2	.9	6.8	.9	.9	.4	.5	-*	7.3
852 Atmosphere Explorers		.4	1.8	1.9	5.0	.8	1.0	.4	.3	.3	6.5
853 Ionosphere Explorers		.2	.8	.9	.8	1.1	.5	.2	-*	-*	2.9
854 Micrometeoroid Satellite S-55, S-55a						---	---	---	---	---	.3
857 Small Scientific Satellites						---	---	---	.7	1.4	2.1
859 University Explorers (Rice University)						---	---	2.4	.4	.9	3.7
861 Interplanetary Explorers/IMP					8.1	4.1	9.3	7.9	6.5	6.2	38.9
863 Air Density/Injun Explorers					.2	.9	.6	1.3	1.5	1.2	5.6
865 Electron Density Explorers						---	---	-*	*	---	.6

Table 4-22. Research and Development Direct Obligations, by Budget Line Item and Unique Project Number (Continued)
(in millions of dollars)[a]

Budget Line Item/Unique Project[b]	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total[c]
85 Physics and astronomy (*cont'd*)											
866 Manned satellite science						.7	3.7	.3	–*	---	4.7
870 United Kingdom Explorers			1.1	1.0	.1	.9	.4	.2	*	–*	6.7
871 *ESRO I* and *II*			.1	2.5	3.5	---	*	.1	*	*	.2
872 ISIS (Int'l Sat. for Ionosphere Studies)		1.1	4.0	7.5	3.3	1.7	1.5	2.1	1.3	1.3	9.0
873 Beacon Explorers		1.4	1.1	1.1	1.2	1.5	1.8	.5	.4	–*	5.1
874 German Research Satellite						---	---	---	*	.1	.1
876 French satellite (*FR-1*)						*	.1	.1	*	---	.2
877 Radio Astronomy Satellites						---	.9	4.4	5.2	2.7	13.3
878 Small Astronomy Satellites						---	---	---	.7	2.7	3.4
879 Sounding rockets	3.1	5.2	7.4	9.0	11.9	15.7	19.0	18.4	21.0	18.7	129.6
894 Joint Italian–United States Project					4.0	.3	.1	.9	*	.6	3.7
895 Juno II payload						–.1	---	---	---	–*	1.0
896 *Vanguard III*	22.0	.8	.1	–3.3		–*	–1.7	---	---	–*	20.9
897 Gamma Ray Astronomy Satellite S-15						–.3	---	–.2	---	–*	29.8
898 Ionosphere Measurement Satellite S-30						–*	–*	–*	---	–*	.9
899 Ionosphere Beacon Satellite S-45						–*	---	---	---	–*	.5
86 Manned space sciences						1.5	7.8	11.4	18.4	3.6	42.3
169 Earth resources SRT						---	---	---	4.2	.3	4.5
190 Manned space sciences SRT						1.0	3.4	.5	.5	–.1	4.7
749 Apollo Applications experiment definition						---	---	.4	1.1	.5	2.0
848 Returned lunar sample analysis						---	---	---	1.8	1.2	3.0
849 Apollo Applications experiment definition						---	---	9.9	7.6	1.1	18.6
860 Manned flight experiments						---	---	---	.1	.3	.3
867 Manned lunar science						.5	4.4	*	*	--	5.0
949 Apollo Applications experiment definition						---	---	.7	3.2	.4	4.2
87 Bioscience			3.1	2.2	10.1	21.1	29.7	35.5	41.2	42.0	186.1
189 Bioscience SRT			3.1	1.7	9.2	13.4	12.3	11.8	9.8	12.2	74.2
880 BIOS						---	–*	---	---	---	.4
881 Infrared spectroscopy						–*	–*	.1	---	---	.9
882 Bio-sampling lunar and planetary flights						---	---	---	---	---	*
883 Biosatellites				.6	.9	7.8	17.3	23.7	31.4	29.8	110.7
89 OSS&A vehicle procurement[d]			(253.1)			127.3	148.9	170.4	140.8	133.7	974.0
180 Launch vehicle SRT					.9	2.1	3.4	2.0	3.8	5.4	17.6
490 Scout procurement			(14.9)			9.0	5.6	6.6	6.7	5.2	48.0

Table 4-22. Research and Development Direct Obligations, by Budget Line Item and Unique Project Number (Continued)
(in millions of dollars)[a]

	Budget Line Item/Unique Project[b]	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total[c]
89	OSS&A vehicle procurement[d] *(cont'd)*											
491	Centaur procurement			(16.2)			32.0	40.0	49.4	46.1	54.0	237.8
492	Delta procurement			(43.9)			22.2	32.6	8.3	18.9	26.9	152.8
493	Agena procurement (excluding Gemini)			(152.8)			48.1	46.6	56.6	32.6	10.6	347.3
494	Atlas procurement (excluding Mercury)			(6.5)			1.4	1.2	*	-*		9.1
495	Thor (Echo) procurement			(3.2)								3.2
497	Sustaining engineering and maintenance			(6.9)		7.7	12.4	19.3	46.6	32.2	31.1	156.2
680	Advanced studies–launch vehicles						---	.3	.6	.5	.5	2.0
91	Gemini				55.0	287.6	419.2	308.3	163.5	48.0	.7	1 283.2
913	Gemini spacecraft				30.6	205.1	280.5	165.3	66.6	46.2	3.2	797.1
923	Gemini support					3.4	16.0	27.7	24.0	4.7	-.9	76.1
939	Gemini launch vehicle				24.4	79.1	122.7	115.4	72.9	-2.9	-1.6	410.0
92	Apollo	10.1	36.1	190.3	446.5	1160.6	2225.0	2708.9	2971.3	2877.9	2535.2	15 169.3
101	Spacecraft supporting technology			3.6	6.6	6.6	6.9	*	-*	-.1	-*	28.4
103	Launch vehicle supporting technology			5.2	5.3	7.9	13.6	1.2	*	-*	-*	31.1
104	Propulsion supporting technology			1.9	8.0	8.4	8.0	.1	-.1	-.2	-*	43.5
105	Launch operations supporting technology			.3	1.2	1.8	2.5	.3	*	-*	-.1	6.2
903	Gemini supporting development						---	3.2	-.1	-*	-*	3.0
904	Apollo supporting development						---	36.2	20.6	6.4	27.0	90.2
905	Apollo Applications supporting development						---	---	11.0	20.3	5.9	37.3
908	Advanced manned missions supporting dev.						---	13.7	2.2	.4	-*	16.4
914	Apollo spacecraft				73.4	361.9	881.4	1017.1	1264.4	1288.0	1097.7	5 977.7
921	Mission control system					7.8	47.7	37.0	3.2	32.7	52.3	181.0
924	Apollo space operations						3.6	29.6	37.8	55.9	50.4	177.3
931	Saturn I vehicle		9.4	96.9	193.3	255.3	188.1	39.3	-2.7	-.9	-.3	767.2
932	Saturn IB vehicle		---	---	---	16.4	149.1	263.6	279.1	223.5	138.8	1 068.0
933	Saturn V vehicle		---	---	54.5	333.9	696.8	1040.9	1158.4	1074.4	1007.0	5 363.8
940	Engine development	10.1	26.7	82.4	99.7	136.5	166.0	165.9	133.1	49.6	20.0	886.7
950	Launch operations support				2.2	4.9	21.8	35.0	33.4	87.1	91.2	275.7
955	Launch instrumentation						8.2	6.6	10.1	12.5	18.2	55.6
980	Systems engineering				2.2	19.0	31.2	19.3	20.9	28.2	27.0	160.2
93	Advanced manned missions					10.1	13.9	20.3	13.4	8.4	1.9	67.9
390	Special support						---	---	---	.5	---	.5
981	Advanced studies					10.1	13.9	20.3	13.4	7.9	1.9	67.4

Table 4-22. Research and Development Direct Obligations, by Budget Line Item and Unique Project Number (Continued)
(in millions of dollars)[a]

Budget Line Item/Unique Project[b]	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total[c]
96 Apollo Applications						---	---	13.8	83.4	122.2	219.3
942 Apollo Applications design and development						---	---	13.8	.2	.1	14.0
945 MSF experiment definition						---	---	---	1.9	10.2	12.1
948 AAP experiment development						---	---	---	3.6	23.8	27.4
961 AAP spacecraft development						---	---	---	22.7	11.1	33.8
964 Orbital Workshop						---	---	---	15.4	20.7	36.1
965 Apollo Telescope Mount						---	---	---	8.3	20.9	29.2
972 AAP Uprated Saturn I production						---	---	---	22.9	14.5	37.4
973 AAP Saturn V production						---	---	---	1.3	2.3	3.6
991 Payload integration						---	---	---	4.0	16.3	20.3
995 Mission operations						---	---	---	3.1	1.1	4.2
996 Program support						---	---	---	---	1.3	1.3
99 Completed missions	43.0	91.3	91.6	55.4	12.0	−.1	−6.3	−.1	.1	−*	295.8
911 Mercury	28.9	87.7	92.4	31.2	−4.3	−.2	−1.9	−*	.1	−*	235.0
912 Manned one-day mission				16.5	16.3	.2	−4.4	−.1	−*	−*	32.4
916 Prospector						---	---	---	−*	---	.1
929 Vega	14.1	3.6	−.8	7.7		---	---	---	---	---	28.2
NN Various early projects[e]	39.9	24.2	9.7	7.0	5.2	---	---	---	---	---	---

[a] For Tables 4-21, 4-22, and 4-23 a line has been drawn between the 1959-1963 period and the 1964-1968 period to indicate an occasional lack of continuity between the two periods. The lack of continuity has three principal causes. First, the 1959-1963 period included vehicle procurement costs with the space flight project (see note [d] below). Second, the coding and accounting structure was in a state of development until about 1963 and it has been difficult to reconstruct the early years. Third, there is a paucity of information from the early years and some of the early projects had to be handled somewhat arbitrarily. The discrepancies between the two periods can be calculated by subtracting years 1964-1968 from the total and comparing it with a total calculated for 1959-1963. An asterisk indicates less than $50 000.

[b] Nomenclature based on Changes 9 and 10 of FMM 9100; i.e., 1968 nomenclature.

[c] Total is what is shown on the current accounts of the agency. Footnote [a] explains why annual amounts may not add to Total.

[d] Footnote [a] explains how vehicle procurement amounts were handled in the 1959-1963 period. Figures in parentheses are for information only.

[e] The amounts on this line are buried in the totals for other programs and projects.

Source: NASA, Office of Programming, Budget Operations Division, *History of Budget. . .1959 Through 1963;* draft History of Budget. . .1964-1966; NASA, Financial Management Division, *Financial Status of Programs: Research and Development;* NASA, *Financial Management Manual,* FMM 9100, Changes 9 and 10.

Table 4-23. Research and Development Direct Obligations, by Unique Project Number
(in millions of dollars)[a]

Unique Project[b]	UPN-BLI	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total[c]
Spacecraft supporting technology	101-92			3.6	6.6	6.6	6.9	*	-*	-0.1	-*	28.4
Launch vehicle supporting technology	103-92			5.2	5.3	7.9	13.6	1.2	*	-*	-*	31.1
Propulsion supporting technology	104-92			1.9	8.0	8.4	8.0	.1	-.1	-.2	-*	43.5
Launch operations supporting technology	105-92			.3	1.2	1.8	2.5	.3	*	-*	-.1	6.2
Space power and electric propulsion. . .SRT	120-71	0.1	.4	4.2	15.3	19.4	23.3	25.4	22.8	34.7	33.8	174.0
Nuclear rocket systems SRT	121-72	.5	.4	.3		.2	.2	1.0	.6	1.8	1.2	5.1
Nuclear rocket propulsion SRT	122-72			*	.7	12.9	19.3	21.1	18.8	15.2	7.9	96.7
Chemical and solar power SRT	123-73		1.1	5.2	4.8	7.8	12.5	15.2	13.2	1.2	*	62.3
Space vehicle systems SRT	124-74		2.4	.4	5.3	17.1	23.3	24.5	25.0	27.5	28.9	157.4
Electronics systems SRT	125-75		2.4	2.9	2.5	14.1	22.3	25.6	29.9	32.3	36.6	170.7
Aeronautics SRT	126-76	2.0	4.7	1.3	.1	6.0	7.7	8.2	11.0	10.3	18.8	62.7
Human factor systems SRT	127-77			.5	2.9	8.7	11.5	14.6	12.6	15.1	16.5	82.8
Chemical propulsion SRT	128-78	6.2	3.5	1.1	5.9	12.6	22.1	17.2	13.5	18.6	15.5	105.8
Research program SRT	129-79			2.2	7.4	17.0	21.2	22.5	21.9	21.8	2.1	135.6
Mission analysis SRT	130-70						---	---	.4	1.1	1.5	3.0
Identification and dissemination	141-65					.9	2.6	2.9	2.7	4.6	1.8	15.5
Economic studies	143-65					1.1	.6	1.4	.8	.7	.5	5.1
Tracking and data acquisition SRT	150-51	.3	3.7	7.0	14.6	12.4	10.6	15.1	13.3	13.0	11.4	106.4
Space applications SRT	160-61	.1	1.9	3.5	4.1	4.3	6.9	6.5	7.6	7.0	17.7	58.5
Communications and navigation SRT	164-61		.8	1.3	4.9	7.7	3.5	1.0	1.7	3.9	.6	26.7
Future applications SRT	165-61						.2	-*	---	---	---	.6
Applications technology SRT	166-61						.5	1.3	1.2	.5	---	3.6
Earth resources SRT	169-86						---	---	---	4.2	.3	4.5
Launch vehicle SRT	180-89					.9	2.1	3.4	2.0	3.8	5.4	17.6
Training grants	181-41				1.4	13.9	19.8	24.5	25.8	15.2	2.4	103.7
Facilities grants	182-41				6.4	6.9	9.1	8.2	7.0	4.9	.6	43.2
Research grants	183-41				2.4	3.9	7.6	12.3	12.4	10.9	8.6	67.7
Socio-economic studies	184-41						.2	---	---	---	---	.2
Lunar and planetary exploration SRT-Science	185-84		2.6	1.0	12.7	12.4	9.9	12.6	13.6	13.5	10.5	136.8
Lunar and planetary exploration SRT-ATD	186-84	12.2	9.5	19.4	4.2	5.8	3.6	8.8	6.8	7.2	7.2	56.3
Lunar and planetary exploration SRT-SS	187-84					2.9	1.3	-.7	---	-*	---	2.6
Physics and astronomy SRT	188-85	2.5	3.0	2.9	9.4	11.9	15.0	17.3	18.8	20.5	22.7	150.9
Bioscience SRT	189-87			3.1	1.7	9.2	13.4	12.3	11.8	9.8	12.2	74.2

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Table 4-23. Research and Development Direct Obligations, by Unique Project Number (Continued)
(in millions of dollars)[a]

Unique Project[b]	UPN-BLI	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total[c]
Manned space sciences SRT	190-86						1.0	3.4	.5	.5	−.1	4.7
Planetary extension program SRT	194-84						---	---	---	---	10.6	10.6
Network operations (T&DA)	311-51	2.0	10.0	11.0	44.0	51.4	68.0	96.7	135.3	184.6	203.4	803.3
Equipment and components (T&DA)	312-51			5.7	6.9	44.2	70.2	147.9	115.6	62.6	49.2	498.9
Nuclear Rocket Dev. Station operations	321-72						.8	.7	2.0	2.3	4.0	9.8
Special support (OSS&A)	380-50						---	---	---	3.5	2.3	5.7
Data analysis (OSS&A)	385-85						---	---	1.6	1.9	2.5	6.0
Special support (OMSF)	390-93						---	---	---	.5	---	.5
Scout procurement[d]	490-89	(14.9)					9.0	5.6	6.6	6.7	5.2	48.0
Centaur procurement[d]	491-89	(16.2)					32.0	40.0	49.4	46.1	54.0	237.8
Delta procurement[d]	492-89	(43.9)					22.2	32.6	8.3	18.9	26.9	152.8
Agena procurement (excluding Gemini)[d]	493-89	(152.8)					48.1	46.6	56.6	32.6	10.6	347.3
Atlas procurement (excluding Mercury)[d]	494-89	(6.5)					1.4	1.2	•	−•	---	9.1
Thor (Echo) procurement[d]	495-89	(3.2)					---	---	---	---	---	3.2
Sustaining engineering and maintenance[d]	497-89	(6.9)				7.7	12.4	19.3	46.6	32.2	31.1	156.2
Advanced studies (T&DA)	581-51						---	---	---	.3	---	.3
Tiros/TOS Improvements	601-61	.6	2.6	3.4	6.3	19.3	7.5	5.6	1.3	3.8	10.0	52.4
Tiros Operational System (TOS)	602-61						---	---	---	---	•	•
Meteorological flight experiments	603-61						---	.6	4.1	5.4	.2	10.4
Nimbus A-D	604-61		.9	6.9	23.4	30.8	40.8	15.0	24.7	24.4	33.2	190.3
Meteorological soundings	607-61				.4	1.0	2.3	2.6	2.6	2.6	3.3	14.9
Systems A (automatic picture taking. . .)	609-61						•	---	---	---	---	.3
International Applications Satellite	610-61						---	---	---	.1	.1	.2
Echo I (nonrigid) A-11	621-61	3.0	1.4	2.1	1.6	−•	.8	---	−•	---	---	1.4
Echo A-12 (Includes AVT)	622-61			2.0	8.3	2.4	1.6	.3	.1	.2	−•	8.3
Rebound	624-61			.2	.1		---	---	---	---	---	1.1
Radiation Measurements	625-61		.4	.6	1.2	−.4	•	---	---	−•	---	1.7
Relay	626-61			7.0	15.3	13.2	5.9	.7	.1	•	−•	33.7
Syncom	627-61			1.3	9.6	14.9	3.8	.4	−.2	−•	−.2	21.0
Applications Technology Satellites (A-E)	630-61						10.2	28.6	31.4	24.6	21.5	116.2
Early Gravity Gradient Test Satellite	632-61						---	3.1	.5	−.1	---	3.5
Applications Technology Satellites (F-G)	635-61						---	---	---	---	.8	.8

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Table 4-23. Research and Development Direct Obligations, by Unique Project Number (Continued)
(in millions of dollars)[a]

Unique Project[b]	UPN-BLI	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total[c]
Advanced Studies–launch vehicles	680-89						---	.3	.6	.5	.5	2.0
Advanced Studies–space applications	682-61						---	---	.4	.3	.4	1.1
Advanced Studies–lunar and planetary	684-84				.4	1.2	1.5	2.2	1.7	2.0	1.2	10.2
Advanced Studies–physics and astronomy	685-85						---	---	.4	.7	-*	1.0
SNAP-8 Development Project	701-71	.3	.6	.6	7.9	16.0	15.4	11.1	5.8	11.8	7.5	77.6
SERT (Space Electric Rocket Test)	704-71			*	3.4	3.2	3.5	2.0	.4	2.9	1.4	14.8
Small nuclear electric. . .flight projects	705-71					1.2	.3	*	-*	-*	---	1.5
RIFT (Reactor in Flight Test)	706-72			.3	1.2	10.4	7.0	.1	-*	-*	-*	18.9
Small biotechnology flights	708-77				.4	.1	*	.9	2.0	1.6	.8	5.8
Small space vehicle flight projects	709-74			1.1	.3	1.5	1.7	1.2	2.0	5.0	1.5	13.1
Small chemical propulsion flight projects	710-78					.3	*	*	---	*	---	.4
Scout reentry heating experiment	711-74				1.7	1.5	.3	.3	2.7	2.2	1.9	7.7
Meteoroid Satellite Project S-55b	712-74						---	---	---	---	---	.1
Meteoroid Satellite Project S-55c, S-55d	713-74				1.0	2.9	.3	.3	---	---	-*	1.8
FIRE	714-74				4.0	13.9	6.1	2.6	.1	.1	-*	20.3
Small electronics systems flight projects	715-75					1.4	2.4	1.6	1.1	.4	-*	6.7
KIWI	717-72	1.0	2.6	8.4	4.7	4.5	1.8	-1.4	.4	---	-*	21.0
Nerva	718-72				19.3	39.6	49.7	36.6	35.3	34.3	28.6	244.8
X-15 research aircraft	719-76					5.6	.8	1.4	.9	.8	3.5	13.0
Supersonic aircraft technology	720-76				.1	4.3	5.9	21.2	11.8	13.7	12.5	69.6
V/STOL aircraft technology	721-76					.9	2.6	2.2	3.0	5.8	7.0	21.5
Pegasus	725-74					4.0	9.9	13.7	1.5	.1	*	29.1
M-1 engine development	726-78				16.7	34.9	24.2	20.9	3.5	2.8	-.2	102.5
Lifting-body flight program	727-74						1.2	.8	1.5	1.0	1.1	5.7
Large solid motor program (S-10)	728-78						---	15.6	8.7	8.5	1.6	34.5
Hypersonic ramjet experiment	729-76						---	2.3	1.1	6.3	7.0	16.7
RAM-C (Radio Attenuation Measurements)	730-75						---	.9	1.3	1.0	.5	3.6
Chemical rocket experimental engineering	731-78						---	6.7	12.9	16.7	13.8	50.2
XB-70 flight research program	732-76						---	---	.2	11.6	10.0	21.9
Aircraft noise alleviation	733-76						---	---	---	4.4	7.1	11.4
Orbiting Frog Otolith (*Ofo*)	735-77						---	---	---	---	.5	.5
OART experiment definition	740-7A						---	---	---	.7	.3	1.0
Apollo Applications experiment definition	749-86						---	---	.4	1.1	.5	2.0

Table 4-23. Research and Development Direct Obligations, by Unique Project Number (Continued)
(in millions of dollars)[a]

Unique Project[b]	UPN-BLI	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total[c]
Advanced studies–nuclear electric systems	780-71						.2	---	.1	-*	---	.3
Advanced studies–space vehicle systems	784-74						.2	2.5	.5	*	-*	3.2
Advanced studies–electronics	785-75						---	---	.2	---	---	.4
Advanced studies–aeronautical systems	786-76						---	.7	.4	*	---	1.1
Advanced studies–mission analysis	789-70						---	---	1.0	1.6	-*	2.5
Ranger	801-84	3.4	11.7	52.3	62.6	89.4	30.2	12.5	-.5	-.4	-.3	169.8
Surveyor	803-84			4.8	38.1	66.3	70.4	82.7	106.0	80.3	33.0	468.5
Surveyor Orbiter	804-84						*	-.1	---	-*	---	1.1
Mariner A	806-84			11.0	-4.0		2.0	-.4	---	-*	-*	19.9
Mariner B	807-84				12.4	5.5	-1.0	-.6	---	---	---	19.2
Mariner-Mars '64	808-84					31.8	37.7	16.2	2.3	.3	-.3	83.2
Mariner R	810-84				39.3	7.7	.1	-.4	---	-.2	---	21.6
Pioneer (IQSY)	811-85					*	15.8	15.1	9.2	10.2	5.9	56.3
Mariner-Mars '66	812-84						7.0	1.6	-.8	-.1	---	7.7
Mariner IV	813-84						---	---	.3	.8	.6	1.6
Lunar Orbiter	814-84				1.2	*	20.0	49.5	56.8	27.2	8.9	162.3
Mariner-Mars '69	816-84						---	---	4.1	30.3	72.6	107.0
Mariner-Venus '67	817-84						---	---	10.9	12.1	3.2	26.2
Voyager	818-82						---	6.7	16.8	10.0	3.1	36.6
Orbiting Solar Observatories	821-85		1.0	4.0	5.8	10.0	12.2	10.7	9.8	10.6	11.6	67.4
Advanced Orbiting Solar Observatories	822-85				.2	.1	7.2	6.9	10.4	-1.0	-*	23.6
Orbiting Astronomical Observatories	831-85		.3	11.6	32.9	39.5	35.3	31.8	22.7	28.0	45.8	242.9
FLOX (fluorine-oxygen) Development	839-83						*	3.7	.5	.2	---	4.5
Orbiting Geophysical Observatories	841-85		.3	8.6	18.4	42.2	32.4	40.1	28.6	24.9	20.7	204.8
Returned lunar sample analysis	848-86						---	---	---	1.8	1.2	3.0
Apollo Applications experiment definition	849-86						---	---	9.9	7.6	1.1	18.6
Energetic Particles Explorers	851-85		0.6	1.2	.9	6.8	0.9	0.9	0.4	0.5	-*	7.3
Atmosphere Explorers	852-85		.4	1.8	1.9	5.0	.8	1.0	.4	.3	.3	6.5
Ionosphere Explorers	853-85		.2	.8	.9	.8	1.1	.5	.2	-*	-*	2.9
Micrometeoroid Satellite S-55, S-55a	854-85						---	---	---	---	---	.3
Geodetic Satellites	855-61						.6	3.4	3.8	3.3	3.1	13.7
Small Scientific Satellites	857-85						---	---	---	.7	1.4	2.1
University Explorers (Rice University)	859-85						---	---	2.4	.4	.9	3.7

Table 4-23. Research and Development Direct Obligations, by Unique Project Number (Continued)
(in millions of dollars)[a]

Unique Project[b]	UPN-BLI	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total[c]
Manned flight experiments	860-86						---	---	---	.1	.3	.3
Interplanetary Explorers/IMP	861-85					8.1	4.1	9.3	7.9	6.5	6.2	38.9
Air Density/Injun Explorers	863-85					.2	.9	.6	1.3	1.5	1.2	5.6
Electron Density Explorers	865-85						---	---	-•	•	---	.6
Manned satellite science	866-85						.7	3.7	.3	-•	---	4.7
Manned lunar science	867-86						.5	4.4	•	•	---	5.0
United Kingdom Explorers	870-85			1.1	1.0	.1	.9	.4	.2	•	-•	6.7
ESRO I and *II*	871-85			.1	2.5	3.5	---	•	.1	•	•	.2
ISIS (Intl. Sat. for Ionosphere Studies)	872-85		1.1	4.0	7.5	3.3	1.7	1.7	2.1	1.3	1.3	9.0
Beacon Explorers	873-85		1.4	1.1	1.1	1.2	1.5	1.5	.5	.4	-•	5.1
German Research Satellite	874-85						---	---	---	•	.1	.1
French satellite (*FR-1*)	876-85						•	.1	.1	•	---	.2
Radio Astronomy Satellites	877-85						---	.9	4.4	5.2	2.7	13.3
Small Astronomy Satellites	878-85						---	---	---	.7	2.7	3.4
Sounding rockets	879-85	3.1	5.2	7.4	9.0	11.9	15.7	19.0	18.4	21.0	18.7	129.6
BIOS	880-87						---	-•	---	---	---	.4
Infrared spectroscopy	881-87						-•	-•	.1	---	---	.9
Bio-sampling lunar and planetary flights	882-87						---	---	---	---	---	•
Biosatellites	883-87				.6	.9	7.8	17.3	23.7	31.4	29.8	110.7
Scout development	890-83	5.5	2.9	7.8	4.4	4.7	-•	.3	•	-•	-•	25.5
Centaur development	891-83	4.0	36.5	62.2	71.8	90.3	108.3	87.9	52.0	29.6	.1	543.3
Delta development	892-83	13.1	11.3	9.3	5.3	3.7	.2	-•	-1.0	-•	---	41.4
Joint Italian/United States project	894-85					4.0	.3	.1	.9	[illegible]	.6	3.7
Juno II payload	895-85						-.1	---	---	---	-•	1.0
Vanguard III	896-85	22.0	.8	.1	-3.3		-•	-1.7	---	---	-•	20.9
Gamma Ray Astronomy Satellite S-15	897-85						-.3	---	-.2	---	-•	29.8
Ionosphere Measurement Satellite S-30	898-85						-•	-•	-•	---	-•	.9
Ionosphere Beacon Satellite S-45	899-85						-•	---	---	---	-•	.5
Gemini supporting development	903-92						---	3.2	-.1	-•	-•	3.0
Apollo supporting development	904-92						---	36.2	20.6	6.4	27.0	90.2
Apollo Applications supporting development	905-92						---	---	11.0	20.3	5.9	37.3
Advanced manned missions supporting dev.	908-92						---	13.7	2.2	.4	-•	16.4

Table 4-23. Research and Development Direct Obligations, by Unique Project Number (Continued)
(in millions of dollars)[a]

Unique Project[b]	UPN-BLI	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total[c]
Mercury	911-99	28.9	87.7	92.4	31.2	-4.3	-.2	-1.9	-*	.1	-*	235.0
Manned one-day mission	912-99				16.5	16.3	.2	-4.4	-.1	-*	-*	32.4
Gemini spacecraft	913-91				30.6	205.1	280.5	165.3	66.6	46.2	3.2	797.1
Apollo spacecraft	914-92				73.4	361.9	881.4	1017.1	1264.4	1288.0	1097.7	5977.7
Prospector	916-99				---	---	---	---	---	-*	---	.1
Mission control system	921-92					7.8	47.7	37.0	3.2	32.7	52.3	181.0
Gemini support	923-91					3.4	16.0	27.7	24.0	4.7	-.9	76.1
Apollo space operations	924-92						3.6	29.6	37.8	55.9	50.4	177.3
Vega	929-99	14.1	3.6	-.8	7.7		---	---	---	---	---	28.2
Saturn I vehicle	931-92		9.4	96.9	193.3	255.3	188.1	39.3	-2.7	-.9	-.3	767.2
Saturn IB vehicle	932-92					16.4	149.1	263.6	279.1	223.5	138.8	1068.0
Saturn V vehicle	933-92				54.5	333.9	696.8	1040.9	1158.4	1074.4	1007.0	5363.8
Gemini launch vehicle	939-91				24.4	79.1	122.7	115.4	72.9	-2.9	-1.6	410.0
Engine development	940-92	10.1	26.7	82.4	99.7	136.5	166.0	165.9	133.1	49.6	20.0	886.7
Apollo Applications design and development	942-96						---	---	13.8	.2	.1	14.0
MSF experiment definition	945-96						---	---	---	1.9	10.2	12.1
AAP experiment definition	948-96						---	---	---	3.6	23.8	27.4
Apollo Applications experiment definition	949-86						---	---	.7	3.2	.4	4.2
Launch operations support	950-92				2.2	4.9	21.8	35.0	33.4	87.1	91.2	275.7
Launch instrumentation	955-92						8.2	6.6	10.1	12.5	18.2	55.6
AAP spacecraft development	961-96						---	---	---	22.7	11.1	33.8
Orbital Workshop	964-96						---	---	---	15.4	20.7	36.1
Apollo Telescope Mount	965-96						---	---	---	8.3	20.9	29.2
AAP Uprated Saturn I production	972-96						---	---	---	22.9	14.5	37.4
AAP Saturn V production	973-96						---	---	---	1.3	2.3	3.6
Systems engineering	980-92				2.2	19.0	31.2	19.3	20.9	28.2	27.0	160.2
Advanced studies	981-93					10.1	13.9	20.3	13.4	7.9	1.9	67.4
Payload integration	991-96						---	---	---	4.0	16.3	20.3
Mission operations	995-96						---	---	---	3.1	1.1	4.2
Program support	996-96						---	---	---	---	1.3	1.3

[a-c] Identical to notes for Table 4-22.

Source: NASA, Office of Programming, Budget Operations Division, *History of Budget. . .1959 Through 1963*, draft History of Budget. . .1964-1966; NASA, Financial Management Division, *Financial Status of Programs: Research and Development*. NASA, *Financial Management Manual*, FMM 9100, Changes 9 and 10.

Table 4-24. Research and Development Reimbursable Obligations, by Project
(in millions of dollars)

Unique Project (over $1 million)	UPN–BLI	1968	1959–1968	Reimburser
Aeronautics SRT	126–76	2.1	6.1	Primarily Army
Network Operations, T&DA	311–51	.6	2.4	Primarily ESSA and Air Force
Special support	380–50	1.5	1.5	Primarily Army
Scout procurement	490–89	1.8	54.5	Primarily Air Force
Delta procurement	492–89	11.6	69.1	Primarily ESSA and ComSatCorp
Tiros Operational System	602–61	14.2	57.0	ESSA
Nimbus Operational System, 0–1, 0–2	606–61	–––	10.8	ESSA
Systems A (Automatic Picture Taking. . .)	609–61	–––	1.6	Primarily Air Force
Nerva	718–72	30.8	244.3	AEC
XB–70 flight research program	732–76	1.3	1.3	Air Force
Sounding rockets	879–85	.1	1.0	Navy and Air Force
Gemini spacecraft	913–91	–*	12.4	Air Force
Saturn V vehicle	933–92	.3	1.5	Primarily Air Force
Subtotal		64.0	463.5	
Other projects		1.5	6.6	
Total reimbursables		65.5	470.1	

Source: NASA, Financial Management Division, *Financial Status of Programs: Research and Development.*

Table 4-25. Research and Development Obligations (Cumulative), by NASA Installation and Major Project (in millions of dollars)[a]

Installation/Major Project (and Unique Project Number)	Obligations to June 30, 1968	
	Direct	Reimbursable
NASA Headquarters–total	1243.9	2.5
Training grants (181)	103.7	---
Research grants (183)	67.5	---
Lunar and planetary SRT–Science (185)	83.1	---
Physics and astronomy SRT (188)	104.9	---
Bioscience SRT (189)	57.4	---
Network operations (311)	63.7	---
Systems engineering	153.7	---
Western Support Office–total	119.6	33.6
Mission Analysis Division	3.4	---
Langley Research Center–total	561.9	57.1
Scout procurement (490)	---	54.5
Lunar Orbiter (814)	162.2	---
Ames Research Center	303.6	5.7
Pioneer–IQSY (811)	56.1	---
Biosatellites (883)	110.5	---
Lewis Research Center–total	1493.1	0.1
Space power and electric propulsion. . .SRT (120)	118.7	---
Centaur procurement (491)	231.3	---
Agena procurement–excluding Gemini (493)	258.8	---
Sustaining engineering and maintenance (497)	80.4	---
SNAP-8 development project (701)	77.5	---
M-1 engine development (726)	98.7	---
Centaur development (891)	358.4	---
Flight Research Center–total	84.4	1.6
Electronics Research Center–total	53.9	---

Installation/Major Project (and Unique Project Number)	Obligations to June 30, 1968	
	Direct	Reimbursable
Goddard Space Flight Center–total	2457.5	109.1
Network operations (311)	579.4	---
Equipment and components (312)	370.2	---
Delta procurement (492)	78.1	---
Tiros ITOS improvement (601)	52.4	---
Tiros Operational System,TOS (602)	---	57.0
Nimbus A-D (604)	190.3	---
Applications Technology Satellites A-E (630)	113.8	---
Orbiting Solar Observatories (821)	66.0	---
Orbiting Astronomical Observatories (831)	239.9	---
Orbiting Geophysical Observatories (841)	203.9	---
Sounding rockets (879)	94.9	---
Wallops Station–total	32.4	0.1
Jet Propulsion Laboratory–total	1530.4	1.8
Tracking and data acquisition SRT (150)	52.6	---
Network operations (311)	136.5	---
Equipment and components (312)	99.4	---
Ranger (801)	169.2	---
Surveyor (803)	466.0	---
Mariner-Mars '66 (808)	82.4	---
Mariner-Mars '69 (816)	106.7	---
Marshall Space Flight Center–total	8358.5	1.5
Agena procurement–excluding Gemini	85.2	---
Centaur development (891)	141.2	---
Saturn I vehicle (931)	753.8	---
Saturn IB vehicle (932)	960.3	---
Saturn V vehicle (933)	5083.3	---
Engine development	885.7	---

Table 4-25. Research and Development Obligations (Cumulative), by NASA Installation and Major Project (Continued)
(in millions of dollars)[a]

Installation/Major Project (and Unique Project Number)	Obligations to June 30, 1968	
	Direct	Reimbursable
Space Nuclear Propulsion Office–Cleveland–total	235.5	244.3
Nerva (718)	214.3	244.3
Space Nuclear Propulsion Office–Nevada–total	25.0	----
Space Nuclear Propulsion Office–W (Headquarters) total (includes SNPO–Albuquerque)	55.4	----
Manned Spacecraft Center–total	7990.8	12.8
Mercury (911)	227.9	----
Gemini spacecraft (913)	797.1	----
Apollo spacecraft (914)	5883.3	----
Mission control system (921)	181.0	----
Gemini support (923)	75.3	----
Apollo space operations (924)	159.1	----
Gemini launch vehicle (939)	410.0	----
Kennedy Space Center–total	833.6	----
Apollo spacecraft (914)	61.7	----
Saturn IB vehicle (932)	107.5	----
Saturn V vehicle (933)	264.9	----
Launch operations support (950)	273.5	----
Launch instrumentation (955)	55.6	----

[a] Projects for which installation obligations exceeded $50 million.

Source: NASA, Financial Management Division, *Financial Status of Programs: Research and Development.*

Table 4-26. Amounts Programmed for Research and Development, by NASA Installation
(in millions of dollars)

Installation	1963 and Before	1964	1965	1966	1967	1968	Total[a]
NASA Headquarters	419.5	157.9	179.5	168.2	152.4	200.0	1 277.5
Western Support Office[b]	74.9	46.5	15.4	18.2	13.0	1.9	169.9
Langley Research Center	83.7	78.1	106.6	124.7	91.5	83.2	567.8
Ames Research Center	18.4	40.3	54.2	64.2	65.6	67.1	309.8
Lewis Research Center	326.9	299.9	323.2	249.9	162.7	131.3	1 493.9
Flight Research Center	11.5	12.8	9.6	17.7	10.2	23.5	85.3
Electronics Research Center		.2	2.7	8.8	16.4	27.0	55.1
Space Nuclear Propulsion Office	73.9	60.3	45.8	50.1	47.8	42.0	319.9
Goddard Space Flight Center	577.5	369.7	374.1	354.9	387.3	430.9	2 494.4
Wallops Station	3.2	4.3	6.2	7.5	6.5	7.2	34.9
Jet Propulsion Laboratory	450.4	184.1	202.3	225.7	213.6	194.4	1 470.5
Marshall Space Flight Center	1610.4	1301.4	1474.0	1549.9	1342.1	1110.2	8 388.0
Manned Spacecraft Center	1079.9	1363.7	1431.5	1515.7	1446.5	1184.7	8 022.0
Kennedy Space Center	10.1	57.1	59.5	134.0	217.1	358.4	836.2
NASA Total	4740.3	3976.3	4284.6	4489.5	4172.7	3861.8	25 525.2

[a] Sum of rounded annual amounts.
[b] Discontinued March 1, 1968.

Source: NASA, Financial Management Division, *Financial Status of Programs: Research and Development*, column "506 White."

Table 4-37. Amounts Programmed for Research and Development, by Program Office Area
(in millions of dollars)

Program Office	1965 and Before	1966	1967	1968	Total
Office of Administration	----	----	---	27.2	27.2
Technology Utilization	10.7	4.8	5.0	4.0	24.5
University Affairs	137.0	46.0	31.0	9.9	223.9
Tracking and Data Acquisition	675.2	231.1	270.3	265.2	1 441.8
Advanced Research and Technology	1 054.0	288.9	269.4	301.8	1 914.1
Space Science and Applications	2 922.8	742.5	584.0	548.0	4 797.3
Manned Space Flight	8 212.5	3187.7	3012.8	2705.7	17 118.7
NASA Total	13 012.2	4500.9	4172.6	3861.8	25 547.5

Source: NASA, Financial Management Division, *Financial Status of Programs: Research and Development*, column "506 White."

Table 4-28. Construction of Facilities Direct Obligations, by Installation
(in millions of dollars)

	Total Program Plan[a]	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total Obligations
Ames Research Center	55.2	1.7	2.4	3.6	3.1	7.0	11.9	13.6	5.8	1.6	0.9	51.6
Electronics Research Center	29.9	---	---	---	---	0	0.1	0.4	4.2	2.4	17.3	24.4
Flight Research Center	6.3	0	1.7	*	0.1	1.7	-0.2	1.5	1.4	.1	0.1	6.3
Goddard Space Flight Center	84.8	3.4	5.7	9.5	13.9	13.0	10.6	16.4	6.4	2.7	3.0	84.6[b]
Kennedy Space Center	917.9	---	1.0	11.5	83.0	204.3	197.8	190.9	117.9	62.9	28.9	898.2[c]
Langley Research Center	74.5	2.4	4.4	7.0	15.5	6.5	9.0	7.2	5.1	9.8	6.0	72.9
Lewis Research Center	113.3	3.1	5.9	10.0	5.1	10.9	26.5	18.6	8.2	7.1	2.4	97.8
Manned Spacecraft Center	171.3[d]	---	---	---	8.7	42.7	39.9	40.0	19.5	11.2	2.4	164.4
Marshall Space Flight Center	143.9[e]	---	---	11.7	6.9	46.2	23.8	27.1	5.3	1.4	0.1	142.5
Michoud Assembly Facility	56.2	---	---	---	5.0	24.7	11.8	10.7	2.1	0.5	0.4	55.2[f]
Mississippi Test Facility	268.1	---	---	---	5.0	72.0	101.9	67.1	18.9	1.3	0.0	266.2
Space Nuclear Propulsion Office	28.2	---	---	---	0.7	13.2	8.0	2.5	0.9	2.1	0.6	28.0
Wallops Station	38.1	6.4	5.1	2.6	7.1	5.3	4.2	3.4	0.6	0.9	2.0	37.6[g]

Table 4-28. Construction of Facilities Direct Obligations, by Installation (Continued)

(in millions of dollars)

	Total Program Plan[a]	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total Obligations
Pacific Launch Operations Office	2.6	---	0.6	0.5	0.9	-*	-*	*	0.3	0.8	-0.7	2.6
Jet Propulsion Laboratory	43.0	---	7.4	6.9	5.9	10.3	4.6	3.9	1.2	0.6	1.1	41.9[h]
Various locations	536.0[i]	3.1	49.1	31.9	34.9	111.5	96.4	118.8	72.6	10.6	0.0	528.9
NASA Total	2572.3[k]	20.1	83.5	95.2	215.8	569.3	546.3	522.1	270.4	115.9	64.5	2503.1[j]
Pre-NASA projects		17.9	6.2	3.0	1.3	.5	.3	.1	---	---	---	29.3
Total obligations		38.0	89.7	98.2	217.1	569.8	546.6	522.2	270.4	115.9	64.5	2532.4

[a] As of June 30, 1968; includes facilities planning and design.

[b] Includes $3.4 million for tracking and data acquisition projects assigned GSFC facilities project numbers.

[c] Includes $5.5 million in tracking and data acquisition projects assigned KSC facilities project numbers; does not include $839 000 programmed (FY 1963) and obligated for modifications to Mercury Control Center which was included with "Various locations."

[d] Does not include $21.7 million programmed (FY 1963) and obligated for Mission Control Center; this project was included with "Various locations."

[e] Does not include $3.8 million programmed (FY 1963) and obligated for Advanced Saturn Dynamic Test Facility; this project was included with "Various locations."

[f] Includes $367 000 programmed (FY 1962) and obligated for modifications to Slidell Computer Operations Office which was reported with "Various locations."

[g] Includes $16.1 million in tracking and data acquisition projects assigned WS facilities project numbers.

[h] Includes $1.2 million in tracking and data acquisition projects assigned JPL facilities project numbers.

[i] Includes unallocated amounts.

[j] Includes $314.1 million for tracking and data acquisition facilities.

[k] Includes $2.1 million reserve for claims ($2 057 625):

(FY 1962 16 000
1963 46 000
1965 750 000
1966 1 245 625).

Source: NASA, Office of Programming, Budget Operations Division, *History of Budget. . .1959 Through 1963*, draft History of Budget. . .1964-1966; NASA, Financial Management Division, *Financial Status of Programs: Construction of Facilities.*

Table 4-29. Fiscal Year Obligations, Costs, and Disbursements as Percentages of Program Year Budget Plan[a]

Category and Program Year	Year Program Began							
	1959	1960	1961	1962	1963	1964	1965	1966
All appropriations								
Obligated, first year	85	86	87	86	89	86	95	96
Disbursed, first year	34	45	49	46	47	49	54	35
Obligated, second year	10	10	11	10	--	11	4	--
Disbursed, second year	46	43	39	40	--	36	35	--
Obligated, third year	3	2	--	--	--	2	--	--
Disbursed, third year	10	6	8	--	--	10	--	--
Obligated, first and second years	95	96	98	96	--	97	99	--
Disbursed, first and second years	80	88	88	86	--	85	89	--
All appropriations for manned space flight								
Obligated, first year	80	95	87	83	89	89	97	99
Disbursed, first year	17	46	48	42	49	53	59	77
Obligated, second year	21	6	13	12	--	8	2	--
Disbursed, second year	70	48	41	42	--	36	34	--
Obligated, third year	*	−2	−2	--	--	2	--	--
Disbursed, third year	12	*	8	--	--	8	--	--
Obligated, first and second years	101	101	100	95	--	97	99	--
Disbursed, first and second years	87	94	89	84	--	89	93	--
Research and development								
Obligated, first year	89	86	89	95	97	94	96	97
Costs, first year	--	--	--	--	--	64	68	77
Disbursed, first year	17	39	44	47	53	53	53	65
Obligated, second year	10	11	10	4	--	6	3	--
Costs, second year	--	--	--	--	--	32	28	--
Disbursed, second year	63	50	46	47	--	40	37	--
Obligated, first and second years	99	97	99	99	--	100	100	--
Costs, first and second years	--	--	--	--	--	96	95	--
Disbursed, first and second years	89	80	90	94	--	93	90	--
R&D for manned space flight:								
Obligated, first year	78	94	93	98	98	97	99	99
Costs, first year	--	--	--	--	--	71	75	87
Disbursed, first year	14	46	47	49	59	59	60	75
R&D for space sciences and applications[b]:								
Obligated, first year	96	81	91	94	95	92	94	93
Costs, first year	--	--	--	--	--	57	63	60
Disbursed, first year	18	32	41	49	47	49	46	48
R&D for advanced research and technology:								
Obligated, first year	74	69	61	94	96	90	87	82
Costs, first year	--	--	--	--	--	43	45	39
Disbursed, first year	19	41	34	28	35	36	33	28
R&D, all others[c]:								
Obligated, first year	64	82	73	88	84	69	69	89
Costs, first year	--	--	--	--	--	32	26	43
Disbursed, first year	22	54	46	60	41	26	22	33
Construction of facilities:								
Obligated, first year	42	70	52	45	57	38	58	48
Costs, first year	--	--	--	--	--	5	12	14
Disbursed, first year	5	17	20	11	7	4	7	8
Obligated, second year	30	22	42	39	--	40	31	--
Costs, second year	--	--	--	--	--	35	57	--
Disbursed, second year	41	55	40	36	--	29	50	--
Obligated, third year	17	7	3	--	--	16	--	--
Costs, third year	--	--	--	--	--	49	--	--
Disbursed, third year	24	15	29	--	--	42	--	--
Obligated, first and second years	72	92	81	84	--	78	89	--
Costs, first and second years	--	--	--	--	--	40	69	--
Disbursed, first and second years	46	72	60	47	--	33	57	--
Administrative operations:								
Obligated, first year	99	99	100	100	97	--	--	--
Disbursed, first year	88	81	82	79	82	--	--	--

[a] Rounded to closest percentage. An asterisk indicates less than half of one percent.

[b] Includes university affairs for 1959-1963 period.

[c] Tracking and data acquisition only for 1959-1963 period.

Source: For 1959-1963, NASA, Office of Programming, Budget Operations Division, *History of Budget . . . 1959 Through 1963*; for 1964-1966, draft History of Budget . . . 1964-1966.

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CHAPTER FIVE

NASA PROCUREMENT

(Data as of 1968)

CHAPTER FIVE

NASA PROCUREMENT

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CHAPTER FIVE

NASA PROCUREMENT

Since FY 1962, more than 90 percent of NASA's annual expenditures have been for goods and services procured from outside contractors. Even before the Space Act was signed on July 29, 1958, large-scale procurement was planned for NASA as a departure from the balance between in-house and contracted effort under the National Advisory Committee for Aeronautics. The NACA had maintained a relatively small contracting staff, for its work was based on an in-house research capability. While the NACA had performed much of its research in response to requirements generated by other organizations, the new space agency would develop its own requirements as program planning expanded.

NASA needed many unique services and products, ranging from whole launch vehicles to miniaturized electronic components. The scope of contracted work varied from feasibility studies for particular projects or parts of projects to the planning and construction of research facilities, sometimes entire new installations.

The Space Act gave NASA authority to develop, construct, test, and operate space vehicles and to contract for the conduct of this work with individuals, corporations, Government agencies, and others. NASA also received the procurement authority outlined in the Armed Services Procurement Act of 1947, which granted certain agencies the option to use both formal advertising and negotiation as procurement methods.

Because the administration of cost contracts (the kind primarily used in R&D work) required day-to-day field supervision, the decision was made in 1958 to decentralize responsibility by letting the field installations handle all procurement within certain dollar limitations. For those awards expected to exceed the prescribed amounts, approval at various stages in the procurement process had to be sought in Headquarters from the Administrator, Deputy Administrator, or, in recent years, the Associate Administrator for Organization and Management. Final approval of source selection in competitive procurements for these awards was given by the Administrator, with the concurrence of the Deputy Administrator and Associate Administrator. This policy required the three top officials of the agency to participate in question and answer sessions with source evaluation boards on every major procurement decision before making their final judgments.

The balance of effort between in-house research and development and contracted work was based on the concept formulated in 1960 that the

NASA Centers should have sufficient in-house capability to allow them to conceive of space flight development projects, develop technical specifications for private contractors, and supervise contractors to ensure high reliability of systems, subsystems, and components in their early development stages. At the same time, NASA management wanted installations to conduct enough research and development work in-house to maintain the excellence of their scientific and technical staffs.

NASA retained in-house the conceptual and preliminary design stage of major projects in every program to be sure that program planning skill was maintained within NASA, that contractors were provided with definitive requirements, and that a sound basis existed for technical direction and supervision of contractor efforts. Four interrelated elements–detailed designing, fabrication, assembly, and test and checkout–were retained in-house for a few selected subsystems (those which would advance the state of the art). Except for these few elements retained in-house to keep the level of technical capability needed to plan and direct the program, NASA contracted out detailed design, fabrication, assembly, and test and checkout. NASA Centers contracted with industry for all production and manufacturing efforts and with the external scientific community for most space flight experiments.

Rapid changes observed throughout the agency after the decison in 1961 to accelerate the NASA program may be measured in procurement trends. The net value of NASA procurement rose from $756 million in FY 1961 to $3.2 billion in FY 1963, a 326.4 percent increase. Since the number of procurement actions only doubled during those years, the average value of the procurement action increased considerably.

Use of the firm-fixed-price contract and the cost-plus-fixed-fee contract began declining after FY 1961, when they represented 15.3 percent and 82.7 percent, respectively, of the net value of awards. The incentive contract began in FY 1962 to play an increasing role in NASA procurement, until by FY 1966 incentive contracts accounted for nearly half the new value of awards and increased to 52 percent of the total by FY 1968.

Stages in the NASA Procurement Process[1]

Procurement Request: Once a project has been approved and a decision made as to the degree of external participation, the responsible organizational unit prepares a procurement request (PR). The PR, after approval by the proper operating officials, becomes the basic working document for the procurement specialist. The PR includes a description of what is wanted and additional information as needed (suggested suppliers, security classification, etc.).

Procurement Plan: On the basis of the PR and other available information, the procurement specialist draws up a procurement plan. This plan outlines in detail each subsequent step to be taken to carry out the procurement action.

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[1] Rosholt, *Administrative History of NASA*, p. 63-65.

It includes a description of the items to be procured, a list of all known sources, a time schedule for completing each major phase of the action, the recommended kind of contract to be used, and special provisions to be included in the contract. If the items to be procured can be clearly and completely defined in specifications and drawings, formal advertising for competitive bids is possible. If the items cannot be well defined (and most R&D work cannot), the negotiation route must be taken, whereby negotiations with potential suppliers (called "sources") are conducted on the basis of competitive technical and business proposals submitted to NASA. The "formal advertising" route usually results in a fixed-price contract whereas the "negotiation route" usually involves a cost reimbursement contract—normally the cost-plus-a-fixed-fee (CPFF) variety. In NASA, 90 percent of the procurement dollar is spent via the negotiation route.

When the procurement plan has been approved by the proper authorities, the stage is set for solicitation.

Soliciting Proposals: At this stage an attempt is made to keep things as competitive as possible. When formal advertising is used, the procurement action is publicized as widely as possible and an "Invitation for Bid" (IFB) is sent to each interested supplier. The IFB contains all information needed to prepare a bid. It is the crucial instrument in bringing user and supplier together.

Negotiation is more complicated. An instrument called a "Request for Proposal" (RFP) is used instead of an IFB. Since a proposal is infinitely more complicated and expensive to prepare than a bid, NASA attempts to limit the sending of RFPs to parties known to be qualified. This necessitates a screening process, which may be done informally through letters and telephone calls or formally through a "pre-proposal conference" held with interested parties. After the screening, RFPs are sent to firms considered to have the required experience, facilities, and capabilities. A firm may submit a proposal even if it does not initially receive an RFP. All larger RFPs are announced in the Department of Commerce's *Business Daily* and thus any firm can request them.

Bid and Proposal Evaluation: When formal advertising is used, it is necessary to make sure that the low bidder is responsible and that his bid meets all requirements. When negotiation is used, a much more elaborate evaluation process is necessary since cost figures are only one factor to be considered. Proposals are usually evaluated from three angles—the quality of the proposal (design, cost, schedules, etc.), the technical competence of the proposer (personnel, facilities, experience), and the managerial competence of the proposer (reporting system, accounting system, etc.). The RFP includes the criteria on which the evaluation is made. Administrative and legal personnel, as well as technical personnel, participate in proposal evaluation.

Source Selection, Contract Negotiation, and Contract Award: In formal advertising, a standard contract is awarded to the lowest responsible and responsive bidder. When negotiation is used, a decision is made, from the evaluation described above, on the supplier to do the work. After selection, negotiations are begun to iron out the details of the contract. Since a CPFF contract is used in most cases, thorny problems of clarifying costs and determining the fee must be solved. When both sides agree, the actual contract award is made.

Contract Administration: The award of a contract is only part of the overall procurement process. What follows may be even more significant. It is true that the contractor has primary responsibility for performance and, for routine procurements, contract administration may be only taking delivery of the goods or services. In R&D contracting, however, numerous interim problems arise in which NASA has vital interest. In such cases, reviewing and evaluating the contractor's progress is very important and may become a specialty in itself. Elaborate reporting techniques have been developed which sometimes reveal the need for NASA to provide technical or administrative assistance to the contractor. NASA may approve certain contractor actions which require changes in costs. In certain cases the contract may have to be modified or terminated.

Contract administration involves NASA operating technicians, procurement specialists, and people from such activities as safety, reporting, and security.

Definition of Terms

Advertised award–Procurement actions resulting from acceptance of bids made by contractors in response to formal advertising.

Award–See Procurement action.

Competitive negotiation–Procurement actions resulting from soliciting proposals or obtaining quotations from two or more sources.

Direct actions (direct awards)–Procurement actions placed directly with business firms and nonprofit institutions or organizations. The term excludes procurement actions placed with or through other Federal agencies.

Intragovernmental award–Procurement actions placed with or through other Federal agencies.

Modification–Any written alteration in the specifications, delivery point, rate of delivery, contract period, price, quantity, or other contract provision of an existing contract, whether accomplished by unilateral action in accordance with a contract provision or by mutual action of the parties to the contract. It includes (a) bilateral actions, such as supplemental agreements, and (b) unilateral actions such as change orders, notices of termination, and notices of the exercise of an option.

Negotiated award–Procurement actions resulting from negotiation procedures authorized under Title 10 U.S.C. 2304(a).

Net value–Net amount of obligations resulting from debit and credit procurement actions.

Noncompetitive negotiation–Procurement actions resulting from the solicitation of proposals from only one source.

Procurement action (Award)–Any of the following transactions which obligates or deobligates funds:

a. Letter contracts or other preliminary notices of negotiated awards.
b. Definitive contracts, including purchase orders.
c. Orders against indefinite delivery contracts.
d. Modifications.

Small business—A concern that meets the pertinent criteria established by the Small Business Administration and set forth in Paragraph 1.701 of the NASA Procurement Regulation. Generally a small business concern is one that is independently owned and operated, is not dominant in its field of operations, and with its affiliates does not employ more than a specified number of persons (usually not more than 500, 750, or 1000) depending on the product called for by the contract. For construction and some service industries, the criterion is a specified annual dollar volume of sales or receipts instead of employment.

Table 5-1. Total Number of Procurement Actions by Kind of Contractor: FY 1960-FY 1968 and Estimated FY 1959
(in thousands)

Kind of Contractor	FY 1960-FY 1968		Estimate for FY 1959	
	Percentage	Number	Percentage	Number
Business	80.0	1531.4[a]	93.0	25.0
Small business	(64% of all business)	(984.6)		
Large business	(36% of all business)	(546.8)		
Nonprofit institutions	1.9	37.5	1.0	0.3
Government agencies	17.0	328.6	6.0	1.6
Jet Propulsion Laboratory[b]	.1	1.4		
Outside United States[c]	1.0	2.1		
Total	100.0	1886.1	100.0	26.9

[a] Includes 14 900 actions placed under General Service Administration contracts in 1961 and 1962 and not classified as to small or large business.

[b] July 1, 1960, through June 30, 1968.

[c] July 1, 1962, through Dec. 31, 1966, only.

Source: NASA, Procurement and Supply Division, *NASA Procurement, October 1, 1958 to June 30, 1960* (Washington, D.C.: NASA, September 1960); NASA, *Annual Procurement Report, Fiscal Year 1961* and reports through *Fiscal Year 1968* (Washington, D.C.: NASA, 1962-1968).

Table 5–2. Number of Actions by Kind of Contractor: Six-Month Periods
(in thousands)

Kind of Contractor	1960		1961				1962				1963			
	7/1–12/31		1/1–6/30		7/1–12/31		1/1–6/30		7/1–12/31		1/1–6/30		7/1–12/31	
	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number
Business	88.2	36.6	88.7	46.1	86.7	48.7	86.3	60.9	94.6	73.8	94.0	102.8	95.9	100.7
Nonprofit institutions	1.2	.5	1.5	.8	1.6	.9	1.4	1.0	.9	0.7	1.6	1.7	1.0[d]	1.1
(Educational)[a]	–	–	–	–	–	–	–	–	(.6)	(.5)	(1.3)	(1.4)	(0.8)[d]	(.8)
(Other institutions)[a]	–	–	–	–	–	–	–	–	(.3)	(.2)	(.3)	(.3)	(.3)[d]	(.3)
Government agencies	10.6	4.4	9.8	5.1	11.7	6.6	12.3	8.7	4.5	3.5	4.3	4.7	3.0	3.2
Jet Propulsion Laboratory	*	9[c]	*	22[c]	*	29[c]	*	19[c]	*	30[c]	.1	70[c]	*	**
Outside United States[b]	–	–	–	–	–	–	–	–	*	30[c]	.1	70[c]	*	**
Total	100.0	41.5	100.0	52.0	100.0	56.2	100.0	70.6	100.0	78.0	100.1[d]	109.4	99.9[d]	105.0

Table 5–2. Number of Actions by Kind of Contractor: Six-Month Periods (Continued)
(in thousands)

Kind of Contractor	1964				1965				1966				1967				1968	
	1/1–6/30		7/1–12/31		1/1–6/30		7/1–12/31		1/1–6/30		7/1–12/31		1/1–6/30		7/1–12/31		1/1–6/30	
	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number
Business	95.8	136.4	82.2	96.2	77.4	138.9	67.2	97.9	68.9	118.7	74.5	95.2	75.5	116.9	67.8	90.8	73.2	114.2
Nonprofit institutions	1.1	1.6	2.2	2.6	2.3	4.1	1.9	2.8	2.2[d]	3.7	2.4[d]	3.1	3.2	5.0	2.0	2.7	3.0	4.7
(Educational)[a]	(.9)	(1.3)	(1.5)	(1.8)	(1.7)	(3.0)	(1.2)	(1.8)	(1.6)[d]	(2.7)	(1.6)[d]	(2.0)	(2.3)	(3.6)	(1.2)	(1.6)	(2.2)	(3.4)
(Other institutions)[a]	(.2)	(.3)	(.7)	(.8)	(.6)	(1.1)	(.7)	(1.0)	(.6)[d]	(1.0)	(.9)[d]	(1.1)	(.9)	(1.4)	(.8)	(1.1)	(.8)	(1.3)
Government agencies	2.9	4.2	15.2	17.8	20.2	36.2	30.5	44.4	28.7	49.5	22.6	28.8	21.1	32.7	29.8	39.9	23.7	36.9
Jet Propulsion Laboratory	.1	.1	.2	.2	.0	.0	.2	.2	.1	.1	.2	.3	.1	.1	.3	.4	–	–
Outside United States[b]	.1	.1	.2	.2	.1	.2	.2	.3	.2	.3	.2	.3	.1	.2	.1	.2	.1	.2
Total	100.0	142.4	100.0	117.0	100.0	179.4	100.0	145.6	100.1[d]	172.3	99.9[d]	127.7	100.0	154.9	100.0	134.0	100.0	156.0

[a] Breakdown of nonprofit institutions first reported for FY 1963.
[b] Category first included in FY 1963.
[c] Actual number, not in thousands.
[d] Discrepancy due to rounding.

*Less than 0.05 percent.
**Less than 50 actions.

Source: NASA, *Semiannual Procurement Report, July 1 Through Dec. 31, 1961* and reports through 1967 (Washington, D.C.: NASA, 1962–1968); NASA, *Annual Procurement Report*, FY 1961–1968.

Table 5–3. Number of Actions by Kind of Contractor and Fiscal Year
(in thousands)

Kind of Contractor	FY 1959[c]		FY 1960		FY 1961		FY 1962		FY 1963	
	%	Number	%	Number	%	Number	%	Number	%	Number
Business	93.0	25.0	94.6	41.7	88.4	82.7	86.4	109.6	94.2	176.6
Nonprofit institutions	1.0	.3	.9	.4	1.4	1.3	1.5	1.9	1.3	2.4
(Educational)[a]	–	–	–	–	–	–	–	–	(1.0)	(1.9)
(Other institutions)[a]	–	–	–	–	–	–	–	–	(.3)	(.5)
Government agencies	6.0	1.6	4.5	2.0	10.2	9.5	12.1	15.3	4.4	8.2
Jet Propulsion Laboratory	–	–	d	d	*	**	*	**	.1	.1
Outside United States[b]	–	–	–	–	–	–	–	–	.1	.1
Total	100.0	26.9	100.0	44.1	100.0	93.5	100.0	126.8	100.1[e]	187.4

Table 5-3. Number of Actions by Kind of Contractor and Fiscal Year (Continued)
(in thousands)

Kind of Contractor	FY 1964		FY 1965		FY 1966		FY 1967		FY 1968	
	%	Number	%	Number	%	Number	%	Number	%	Number
Business	95.8	237.1	79.3	235.1	68.1	216.6	75.0	212.1	70.7	205.0
Nonprofit institutions	1.1	2.7	2.3[d]	6.7	2.1	6.5	2.9	8.1	2.6	7.4
(Educational)[a]	(.9)	(2.1)	(1.6)[d]	(4.8)	(1.4)	(4.5)	(2.0)	(5.6)	(1.7)	(5.0)
(Other institutions)[a]	(.2)	(.6)	(.6)[d]	(1.9)	(.7)	(2.0)	(.9)	(2.5)	(.8)	(2.4)
Government agencies	3.0	7.4	18.2	54.0	29.5	93.9	21.8	61.5	26.5	76.8
Jet Propulsion Laboratory	*	0.1	.1	.2	.1	.3	.1	.4	.1	.4
Outside United States[b]	*	0.1	.1	.4	.2	.6	.2	.5	.1	.4
Total	99.9	247.4	100.0	296.4	100.0	317.9	100.0	282.6	100.0	290.0

[a] Breakdown of nonprofit institutions first reported for Fiscal Year 1963.

[b] Category first included in FY 1963.

[c] Number of actions in FY 1959 not available from Procurement Report. Rough estimate only.

*Less than 1.0 percent.

**Less than 100 actions.

[d] No listing of number of actions for JPL in FY 1960 report (*NASA Procurement*).

[e] Discrepancy due to rounding.

Source: NASA, *NASA Procurement*, 1958–1960, and *Annual Procurement Report*, FY 1961–1968.

Table 5-4. Number of Actions Awarded Small and Large Business: Six-Month Periods
(in thousands)

	1960		1961				1962				1963			
	7/1-12/31		1/1-6/30		7/1-12/31		1/1-6/30		7/1-12/31		1/1-6/30		7/1-12/31	
Kind of Business	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number
Small business	65	25.7	64	31.6	66	35.0	65	42.9	66	48.4	67	68.8	68	68.5
Large business	35	13.7	36	17.6	34	17.7	35	23.0	34	25.4	33	34.0	32	32.2
Total	100	39.4	100	49.2	100	52.7	100	65.9	100	73.8	100	102.8	100	100.7
Part of total placed through GSA (if any)		2.9		3.0		3.9		5.1						

Table 5-4. Number of Actions Awarded Small and Large Business: Six-Month Periods (Continued)
(in thousands)

	1964				1965				1966				1967				1968	
	1/1-6/30		7/1-12/31		1/1-6/30		7/1-12/31		1/1-6/30		7/1-12/31		1/1-6/30		7/1-12/31		1/1-6/30	
Kind of Business	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number
Small business	63	85.6	62	59.7	64	88.9	65	63.2	64	75.6	63	60.1	63	73.6	64	58.0	63	71.6
Large business	37	50.8	38	36.5	36	50.0	35	34.7	36	43.1	37	35.1	37	43.3	36	32.8	37	42.6
Total	100	136.4	100	96.2	100	138.9	100	97.9	100	118.7	100	95.2	100	116.9	100	90.8	100	114.2

Source: NASA, *Semiannual Procurement Report*, 1961-1967, and *Annual Procurement Report*, FY 1961-1968.

Table 5–5. Number of Actions Awarded Small and Large Business by Fiscal Year
(in thousands)

Kind of Business	FY 1960		FY 1961		FY 1962		FY 1963		FY 1964		FY 1965		FY 1966		FY 1967		FY 1968	
	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number
Small business	66	27.4	65	57.3	66	77.9	66	117.2	65	154.1	63	148.6	64	138.8	63	133.7	63	129.6
Large business	34	14.3	35	31.3	34	40.7	34	59.4	35	83.0	37	86.5	36	77.8	37	78.4	37	75.4
Total	100	41.7	100	88.6[a]	100	118.6[b]	100	176.6	100	237.1	100	235.1	100	216.6	100	212.1	100	205.0
Part of total placed through GSA (if any)		0		5.9		9.0		0										

[a] Includes 5.9 thousand actions placed under General Service Administration contracts.

[b] Includes 9.0 thousand actions placed under General Service Administration contracts.

Source: NASA, *NASA Procurement*, 1958–1960, and *Annual Procurement Report*, FY 1961–1968.

Table 5-6. Total Procurement Value by Kind of Contractor: FY 1960-FY 1968
(in millions)

Kind of Contractor	Percentage	Amount
Business	77.9	$22 990.3[a]
Small business	(7.0% of all business)	(1 598.0)
Large business	(93.0% of all business)	(21 392.3)
Nonprofit institutions	3.4	1 016.6
Government agencies	12.8	3 761.2
Jet Propulsion Laboratory	5.6	1 638.1
Outside United States[b]	0.3	106.4
Total	100.0	29 512.6
Method of Procurement (Business)		
Competitive awards	63.8	$14 620.5
Noncompetitive awards	36.2	8 311.9
Total	100.0	22 932.4[c]

[a] Includes $40.2 million worth of 1961 and 1962 actions placed under General Services Administration contracts and not classified as to large or small business.

[b] July 1, 1962, through Dec. 31, 1966, only.

[c] Does not add to business total because it does not include the $40.2 million in footnote a or $17.7 million representing amendments, purchases not exceeding $2500, and purchases under General Services Administration contracts in FY 1960. These amounts were not classified as to competitive or noncompetitive awards.

Source: NASA, *Procurement Report*, 1958-1960, and *Annual Procurement Report*, FY 1961-1968.

Table 5–7. Value of Awards by Kind of Contractor: Six-Month Periods
(in millions)

Kind of Contractor	1960		1961				1962				1963				1964			
	7/1–12/31		1/1–6/30		7/1–12/31		1/1–6/30		7/1–12/31		1/1–6/30		7/1–12/31		1/1–6/30		7/1–12/31	
	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount
Business	48	$163.5	63	$259.8	50	$316.5	77.5	$713.6	63.2	$ 826.1	74.7	$1435.6	75.5	$1464.4	77.5	$2056.7	81.5	$2386.0
Nonprofit institutions	3	10.0	4	14.5	4	22.7	3.0	27.5	2.7	35.3	3.5	66.9	2.6	49.7	3.5	92.3	1.5	43.3
(Educational)[a]	–	–	–	–	–	–	–	–	(2.2)	(28.8)	(3.0)	(58.1)	(2.2)	(42.1)	(2.7)	(70.8)	(1.3)	(37.6)
(Other institutions)[a]	–	–	–	–	–	–	–	–	(.5)	(6.5)	(.5)	(8.8)	(.4)	(7.6)	(.8)	(21.5)	(.2)	(5.7)
Government agencies	31	106.7	27	115.0	27	169.1	16.6	152.7	22.7	297.0	17.2	331.5	14.9	288.5	15.2	404.1	12.5	366.1
Jet Propulsion Laboratory	18	59.7	6	26.3	19	121.7	2.9	26.8	11.2	146.8	4.3	83.4	6.8	132.8	3.5	93.4	4.4	128.8
Outside United States[b]	–	–	–	–	–	–	–	–	0.2	2.1	0.3	5.8	0.2	3.8	0.3	8.2	0.1	3.7
Total	100	$339.9	100	$415.6	100	$630.0	100.0	$920.6	100.0	$1307.3	100.0	$1923.2	100.0	$1939.2	100.0	$2654.7	100.0	$2927.9

Table 5–7. Value of Awards by Kind of Contractor: Six-Month Periods (Continued)
(in millions)

Kind of Contractor	1965				1966				1967				1968	
	1/1–6/30		7/1–12/31		1/1–6/30		7/1–12/31		1/1–6/30		7/1–12/31		1/1–6/30	
	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount
Business	77.7	$1755.4	83.1	$2309.3	79.0	$1778.4	85.5	$2381.8	79.4	$1482.3	85.3	$1879.9	81.2	$1566.8
Nonprofit institutions	5.4	121.5	2.1	58.5	5.3	119.2	2.1	57.2	6.2	115.3	2.5	54.8	5.7	110.3
(Educational)[a]	(4.5)	(101.9)	(1.6)	(44.2)	(4.7)	(105.8)	(1.7)	(46.1)	(4.7)	(86.8)	(1.9)	(41.8)	(4.6)	(89.7)
(Other institutions)[a]	(.9)	(19.6)	(.5)	(14.3)	(.6)	(13.4)	(.4)	(11.1)	(1.5)	(28.5)	(.6)	(13.0)	(1.1)	(20.6)
Government agencies	11.4	256.7	9.0	249.5	11.7	263.0	6.7	186.2	9.7	180.7	5.6	123.7	8.5	163.3
JPL	5.2	118.4	5.2	145.3	3.8	85.0	5.0	140.5	4.4	81.7	5.7	125.9	4.2	81.3
Outside United States[b]	.3	7.5	.6	16.5	.3	6.9	.7	19.0	.3	6.2	.8	18.5	.4	8.2
Total	100.0	$2259.5	100.0	$2799.1	100.1[c]	$2252.5	100.0	$2784.7	100.0	$1866.2	99.9[c]	$2202.8	100.0	$1929.9

[a] Breakdown of nonprofit organizations first reported in *Semiannual Procurement Report* for July 1, 1962, through Dec. 31, 1962.

[b] Category first included in *Semiannual Procurement Report* for July 1, 1962, through Dec. 31, 1962.

[c] Discrepancy due to rounding.

Source: NASA, *Semiannual Procurement Report*, 1961–1967, and *Annual Procurement Report*, FY 1961–1968.

Table 5-8. Value of Awards by Kind of Contractor and Fiscal Year
(in millions)

Kind of Contractor	FY 1959[a]		FY 1960		FY 1961		FY 1962		FY 1963	
	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount
Business	41	$ 88	52	$174.0	56	$423.3	66	$1030.1	70.0	$2261.7
Nonprofit institutions	3	6	5	17.0	3	24.5	3	50.2	3.2	102.2
(Educational)[b]	–	–	–	–	–	–	–	–	(2.7)	(86.9)
(Other institutions)[b]	–	–	–	–	–	–	–	–	(.5)	(15.3)
Government agencies	45	97	32	107.4	29	221.7	21	321.8	19.5	628.5
Jet Propulsion Laboratory	11	23	11	38.3	12	86.0	10	148.5	7.1	230.2
Outside United States[c]	–	–	–	–	–	–	–	–	.2	7.9
Total	100	$214	100	$336.7	100	$755.5	100	$1550.6	100.0	$3230.5

Table 5-8. Value of Awards by Kind of Contractor and Fiscal Year (Continued)
(in millions)

Kind of Contractor	FY 1964		FY 1965		FY 1966		FY 1967		FY 1968	
	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount
Business	76.7	$3521.1	79.8	$4141.4	81.2	$4087.7	83.1	$3864.1	83.4	$3446.7
Nonprofit institutions	3.1[d]	142.0	3.2	164.8	3.5[d]	177.7	3.7	172.5	4.0	165.1
(Educational)[b]	(2.4)[d]	(112.9)	(2.7)	(139.5)	(3.0)[d]	(150.0)	(2.9)	(132.9)	(3.2)	(131.5)
(Other institutions)[b]	(.6)[d]	(29.1)	(.5)	(25.3)	(.6)[d]	(27.7)	(.8)	(39.6)	(.8)	(33.6)
Government agencies	15.1	692.6	12.0	622.8	10.2	512.5	7.9	366.9	6.9	287.0
Jet Propulsion Laboratory	4.9	226.2	4.8	247.2	4.6	230.3	4.8	222.2	5.0	207.2
Outside United States[c]	.3	12.0	.2	11.2	.5	23.4	.5	25.2	.7	26.7
Total	100.0	$4593.9	100.0	$5187.4	100.0	$5031.6	100.0	$4650.9	100.0	$4132.7

[a] For the period Oct. 1, 1958, through June 30, 1959, only.

[b] Breakdown of nonprofit institutions first reported for FY 1963.

[c] Category first included in FY 1963.

[d] Discrepancy due to rounding.

Source: NASA, *NASA Procurement*, 1958-1960, and *Annual Procurement Report*, FY 1961-1968.

Table 5-9. Value of Awards to Small and Large Business: Six-Month Periods
(in millions)

	1960		1961				1962				1963				1964			
	7/1–12/31		1/1–6/30		7/1–12/31		1/1–6/30		7/1–12/31		1/1–6/30		7/1–12/31		1/1–6/30		7/1–12/31	
Kind of Business	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount
Small business	16	$ 28.5	14	$ 36.8	12	$ 39.6	12	$ 83.7	9	$ 71.6	8	$ 119.7	6	$ 93.9	7	$ 146.4	5	$ 113.6
Large business	84	146.5	86	228.2	88	291.5	88	638.8	91	754.5	92	1315.9	94	1370.5	93	1910.3	95	2272.4
Total	100	$175.0	100	$265.0	100	$331.1	100	$722.5	100	$826.1	100	$1435.6	100	$1464.4	100	$2056.7	100	$2386.0
Part of total placed through GSA (if any)		11.5		5.2		14.6		8.9										

Table 5-9. Value of Awards to Small and Large Business: Six-Month Periods (Continued)
(in millions)

	1965				1966				1967				1968	
	1/1–6/30		7/1–12/31		1/1–6/30		7/1–12/31		1/1–6/30		7/1–12/31		1/1–6/30	
Kind of Business	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount
Small business	10	$ 172.7	5	$ 115.0	8	$ 140.9	4	$ 92.3	8.0	$ 124.6	4.0	$ 84.7	7.0	$ 104.9
Large business	90	1582.7	95	2194.3	92	1637.5	96	2289.5	92.0	1357.7	96.0	1795.2	93.0	1461.9
Total	100	$1755.4	100	$2309.3	100	$1778.4	100	$2381.8	100.0	$1482.3	100.0	$1879.9	100.0	$1566.8

Source: NASA, *Semiannual Procurement Report*, 1961–1967, and *Annual Procurement Report*, FY 1961–1968.

Table 5-10. Value of Awards to Small and Large Business by Fiscal Year
(in millions)

Kind of Business	FY 1959[a]		FY 1960		FY 1961		FY 1962		FY 1963	
	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount
Small business	18	$16	17	$ 29.1	15	$ 65.3	12	$ 123.3	8	$ 191.3
Large business	82	72	83	144.9	85	374.7	88	930.3	92	2070.4
Total	100	$88	100	$174.0	100	$440.0	100	$1053.6	100	$2261.7
Part of total placed through GSA (if any)		0		0		16.7		23.5		0

Table 5-10. Value of Awards to Small and Large Business by Fiscal Year (Continued)
(in millions)

Kind of Business	FY 1964		FY 1965		FY 1966		FY 1967		FY 1968	
	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount
Small business	7	$ 240.3	7	$ 286.3	6	$ 255.9	6.0	$ 216.9	6.0	$ 189.6
Large business	93	3280.8	93	3855.1	94	3831.8	94.0	3647.2	94.0	3257.1
Total	100	$3521.1	100	$4141.4	100	$4087.7	100.0	$3864.1	100.0	$3446.7

[a] For the period Oct. 1, 1958, through June 30, 1959, only.

Source: NASA, *NASA Procurement*, 1958-1960, and *Annual Procurement Report*, FY 1961-1968.

Table 5-11. Value of Awards to Business, Competitive and Noncompetitive Procurement: Six-Month Periods[a]
(in millions)

	1960		1961				1962				1963				1964			
	7/1-12/31		1/1-6/30		7/1-12/31		1/1-6/30		7/1-12/31		1/1-6/30		7/1-12/31		1/1-6/30		7/1-12/31	
Kind of Procurement	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount
Competitive	63	$103.3	67	$173.5	51	$161.6	57	$404.2	56	$466.3	58	$835.7	57	$840.0	62	$1279.5	68	$1617.5
Noncompetitive	37	60.2	33	86.3	49	154.9	43	309.4	44	359.8	42	599.9	43	624.4	38	777.2	32	768.5
Total	100	$163.5	100	$259.8	100	$316.5	100	$713.6	100	$826.1	100	$1435.6	100	$1464.4	100	$2386.0	100	$2386.0

Table 5-11. Value of Awards to Business, Competitive and Noncompetitive Procurement: Six-Month Periods[a] (Continued)
(in millions)

	1965				1966				1967				1968	
	1/1-6/30		7/1-12/31		1/1-6/30		7/1-12/31		1/1-6/30		7/1-12/31		1/1-6/30	
Kind of Procurement	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount
Competitive	58	$1012.6	65	$1508.9	67	$1183.6	72	$1709.2	67.0	$ 989.4	69.0	$1302.0	64.0	$1005.8
Noncompetitive	42	742.8	35	800.4	33	594.8	28	672.8	33.0	492.9	31.0	577.9	36.0	561.0
Total	100	$1755.4	100	$2309.3	100	$1778.4	100	$2381.8	100.0	$1482.3	100.0	$1879.9	100.0	$1566.8

[a] Excludes purchases under $2500, through GSA, and amendments–not classified as competitive or noncompetitive.

Source: NASA, *Semiannual Procurement Report*, 1961-1967, and *Annual Procurement Report*, FY 1961-1968.

Table 5-12. Value of Awards to Business, Competitive and Noncompetitive Procurement by Fiscal Year
(in millions)

Kind of Procurement	FY 1959[a]		FY 1960		FY 1961		FY 1962		FY 1963	
	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount
Competitive	33	$26	18	$ 27.6	65	$276.8	55	$ 565.8	58	$1302.0
Noncompetitive	67	54	82	128.7	35	146.5	45	464.3	42	959.7
Total	100	$80[b]	100	$156.3[b]	100	$423.3	100	$1030.1	100	$2261.7

Table 5-12. Value of Awards to Business, Competitive and Noncompetitive Procurement by Fiscal Year (Continued)
(in millions)

Kind of Procurement	FY 1964		FY 1965		FY 1966		FY 1967		FY 1968	
	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount
Competitive	60	$2119.5	63	$2630.1	66	$2692.5	70.0	$2698.4	67.0	$2307.8
Noncompetitive	40	1401.6	37	1511.3	34	1395.2	30.0	1165.7	33.0	1138.9
Total	100	$3521.1	100	$4141.4	100	$4087.7	100.0	$3864.1	100.0	$3446.7

[a] For the period Oct. 1, 1958, through June 30, 1959, only.

[b] Excludes purchases under $2500, through GSA, and amendments–not classified as competitive or noncompetitive.

Source: NASA, *NASA Procurement*, 1958–1960, and *Annual Procurement Report*, FY 1961–1968.

Table 5-13. Value of Direct Awards to Business by Contract Pricing Provision: FY 1961–FY 1968[a]
(in millions)

Pricing Provision	FY 1961		FY 1962		FY 1963		FY 1964		FY 1965		FY 1966		FY 1967		FY 1968	
	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount
Incentive	*	$ 0.1	1.4	$ 13.1	7.7	$ 162.7	7.9	$ 269.3	15.1	$ 602.2	48.7	$1922.5	68.0	$2567.6	51.9	$1735.4
Fixed price	*	.1	.4	3.8	.5	10.2	.8	27.2	2.5	100.6	1.9	73.6	3.1	117.1	2.1	71.3
Cost reimbursable	–	–	1.0	9.3	7.2	152.5	7.1	242.1	12.6	501.6	46.8	1848.9	64.9	2450.5	49.8	1664.1
Other fixed price	15.5	56.3	13.8	125.4	11.9	251.8	11.5	388.4	12.3	492.5	10.3	407.1	10.9	411.3	9.2	310.0
Firm	15.3	55.4	13.8	125.0	11.7	247.5	11.5	387.0	12.3	492.0	10.1	399.2	10.9	409.5	9.2	308.8
Redeterminable	.2	.9	*	.4	.2	4.1	*	1.4	*	.3	*	1.3	*	1.2	*	.9
Escalation	–	–	–	–	*	.2	–	–	*	.2	.2	6.6	*	.6	*	.3
Other cost reimbursable	82.9	300.4	83.7	760.2	80.0	1692.5	80.3	2713.6	72.2	2885.5	40.8	1612.1	20.7	780.7	38.4	1282.2
Cost-no-fee	.1	.3	1.2	11.1	3.4	71.4	1.4	46.5	1.1	42.9	.5	20.8	.2	5.6	.5	15.0
Cost-plus-fixed-fee	82.7	299.9	82.4	748.6	76.5	1618.0	78.8	2664.9	71.1	2841.3	40.3	1591.0	20.5	774.6	37.8	1263.2
Cost sharing	.1	.2	.1	.5	.1	3.1	.1	2.2	*	1.3	*	.3	*	.5	.1	4.0
Labor hour	–	–	*	.2	.1	1.3	.1	1.7	.1	2.0	*	.1	*	.7	*	.9
Time and materials	1.6	5.7	1.0	9.5	.3	5.5	.2	6.6	.3	10.8	.2	9.4	.4	15.1	.3	10.1
Total	100.0	$362.5	100.0	$908.4	100.0	$2113.8	100.0	$3379.6	100.0	$3993.0	100.0	$3951.2	100.0	$3775.4	99.8[b]	$3338.6

[a] R&D contracts of $10 000 and over and all other contracts of $25 000 and over.
[b] Discrepancy due to rounding.

Source: NASA, *Annual Procurement Report*, FY 1966, p. 64.
*Less than 0.05 percent.

Table 5-14. Value of Direct Awards to Business by Contract Pricing Provision: Six-Month Periods[a]
(in millions)

Pricing Provision	1960		1961				1962				1963			
	7/1–12/31		1/1–6/30		7/1–12/31		1/1–6/30		7/1–12/31		1/1–6/30		7/1–12/31	
	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount
Incentive	0.1	$ 0.1	–	–	–	–	2.1	$ 13.1	6.5	$ 48.9	8.4	$ 113.8	5.6	$ 79.0
Fixed price	.1	.1	–	–	–	–	.6	3.8	.1	.4	.7	9.8	.6	8.5
Cost reimbursable	–	–	–	–	–	–	1.5	9.3	6.4	48.5	7.7	104.0	5.0	70.5
Other fixed price	18.1	27.0	13.7	$ 29.3	16.7[b]	$ 47.6	12.5	77.8	11.9	90.0	11.9	161.8	9.7	136.6
Firm	17.5	26.2	13.7	29.2	16.7[b]	47.4	12.4	77.6	11.8	89.2	11.7	158.3	9.7	136.1
Redeterminable	.6	.8	*	.1	.1[b]	.2	*	.2	.1	.8	.2	3.3	*	.5
Escalation	–	–	–	–	–	–	–	–	–	–	*	.2	–	–
Other cost reimbursable	80.4	120.0	84.6	180.4	81.9	232.9	84.5[b]	527.3	81.1	613.2	79.5	1079.3	84.4[b]	1183.2
Cost-no-fee	–	**	.1	.3	.1	.2	1.7[b]	10.9	3.4	25.9	3.4	45.5	1.0[b]	14.7
Cost-plus-fixed-fee	80.4	120.0	84.4	179.9	81.7	232.3	82.7[b]	516.3	77.3	584.5	76.1	1033.5	83.2[b]	1167.2
Cost sharing	–	–	.1	.2	.1	.4	*	.1	.4	2.8	*	.3	.1	1.3
Labor hour	–	–	–	–	–	–	*	.2	.1	.6	.1	.7	.1	1.1
Time and materials	1.5	2.2	1.6	3.5	1.4	3.9	.9	5.6	.5	3.7	.1	1.8	.2	2.7
Total	100.1[b]	$149.3	99.9[b]	$213.2	100.0	$284.4	100.0	$624.0	100.1[b]	$756.4	100.0	$1357.4	100.0	$1402.6

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Table 5-14. Value of Direct Awards to Business by Contract Pricing Provision: Six-Month Periods[a] (Continued)
(in millions)

Pricing Provision	1964				1965				1966				1967				1968	
	1/1-6/30		7/1-12/31		1/1-6/30		7/1-12/31		1/1-6/30		7/1-12/31		1/1-6/30		7/1-12/31		1/1-6/30	
	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount
Incentive	9.6	$ 190.3	9.0	$ 209.6	23.4[b]	$ 392.6	22.1	$ 497.2	83.8	$1425.3	64.8	$1521.0	73.3	$1046.6	60.7	$1110.2	41.4	$ 625.2
Fixed price	.9	18.7	3.0	69.5	1.9[b]	31.1	1.8	39.9	2.0	33.7	1.3	30.5	6.1	86.6	2.5	46.3	1.7	25.0
Cost reimbursable	8.7	171.6	6.0	140.1	21.6[b]	361.5	20.3	457.3	81.8	1391.6	63.5	1490.5	67.2	960.0	58.2	1063.9	39.7	600.2
Other fixed price	12.7	251.8	9.9	229.9	15.7	263.2	9.1	204.2	13.4	227.5	8.2[b]	191.5	15.4	219.8	8.2	150.4	10.6	159.6
Firm	12.7	250.9	9.9	228.9	15.7	263.1	7.7	172.8	13.3	226.4	8.1[b]	190.9	15.3	218.6	8.2	150.0	10.5	158.8
Redeterminable	*	.9	*	.9	–	[c]	*	.2	.1	1.1	*[b]	.2	*	1.0	*	.2	*	.7
Escalation	–	–	*	.1	*	.1	1.4	31.2	–	[d]	*[b]	.4	*	.2	*	.2	*	.1
Other cost reimbursable	77.4	1530.4	80.7	1871.4	60.6	1014.1	68.7	1545.1	3.9	67.0	26.8	628.4	10.7	152.3	30.8	563.4	47.6	718.8
Cost-no-fee	1.6	31.8	1.0	22.7	1.2	20.2	.4	9.4	.7[b]	11.4	.1	1.3	.3	4.3	.3	.5	1.0	14.5
Cost-plus-fixed-fee	75.8	1497.7	79.7	1848.6	59.3	992.7	68.3	1535.6	3.3[b]	55.4	26.7	627.1	10.3	147.5	30.7	561.9	46.4	701.3
Cost sharing	*	.9	*	.1	.1	1.2	*	.1	*	.2	*	***	*	***	.1	2.0	.7	2.0
Labor hour	*	.6	.1	1.2	*	.8	*	***	*	.1	*	.2	*	.5	*	.2	*	.7
Time and materials	.2	3.9	.3	6.9	.2	3.9	.1	3.2	.4	6.2	.3	6.3	.6	8.8	.2	4.3	.3	5.8
Total	99.9[b]	$1977.0	100.0	$2319.0	99.9[b]	$1674.6	100.0	$2249.7	100.1[b]	$1701.5	100.1[b]	$2347.4	100.0	$1428.0	99.9[b]	$1828.5	99.9[b]	$1510.1

[a] Includes contracts of $25 000 and above for FY 1964-1967, and contracts of $25 000 and above, plus R&D contracts of $10 000 and above for FY 1961-1963.

[b] Discrepancy due to rounding.

[c] Procurement Report for FY 1965 gives $0.3 million for the entire year, but report for July 1, 1964, through Dec. 31, 1964, reports $0.9 million for the first half of FY 1965 alone.

[d] FY 1966 Procurement Report gives $6.6 million for the entire fiscal year, but Semiannual Procurement Report for July 1, 1965, through Dec. 31, 1965, gives $31.2 million for the first half of FY 1965 alone.

*Less than 0.05 percent.

**Less than $0.1 million.

***Less than $50 000.

Source: NASA, *Semiannual Procurement Report*, 1961-1967, and *Annual Procurement Report*, FY 1961-1968.

Table 5-15. Total Number of Actions in Direct Awards to Business by Contract Pricing Provisions: Six-Month Periods
(in thousands)

	1960		1961				1962				1963				1964	
	7/1–12/31		1/1–6/30		7/1–12/31		1/1–6/30		7/1–12/31		1/1–6/30		7/1–12/31		1/1–6/30	
Pricing Provision	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number
Incentive	0.2	1	–	–	–	–	0.6	10	1.9[a]	26	1.5[a]	42	2.8[a]	66	3.3	171
Fixed price	.2	1	–	–	–	–	.2	4	.1[a]	2	.1[a]	3	.6[a]	10	.7	38
Cost reimbursable	–	–	–	–	–	–	.4	6	1.7[a]	24	1.3[a]	39	2.3[a]	56	2.6	133
Other fixed price	56.7	242	36.7[a]	309	40.6	310	40.3	674	46.0[a]	645	45.6	1320	47.0	1127	47.5	2438
Firm	54.8	234	36.4[a]	307	40.3	308	40.1	671	45.3[a]	636	45.1	1395	46.8	1122	47.3	2428
Redeterminable	1.9	8	.2[a]	2	.3	2	.2	3	.6[a]	9	.4	13	.2	5	.2	10
Escalation	–	–	–	–	–	–	–	–	–	–	.1	2	–	–	–	–
Other cost reimbursable	39.6	169	59.3[a]	500	56.4	431	55.6	930	49.1	689	51.7	1496	48.1[a]	1153	48.2	2473
Cost-no-fee	.7	3	.2[a]	2	.1	1	1.5	25	2.0	28	1.8	52	1.0[a]	25	1.4	70
Cost-plus-fixed-fee	38.9	166	58.8[a]	496	56.0	428	54.0	904	46.9	658	49.7	1438	46.6[a]	1119	46.7	2396
Cost sharing	–	–	.2	2	.3	2	.1	1	.2	3	.2	6	.4[a]	9	.1	7
Labor hour	–	–	–	–	–	–	.2	3	.4	5	.3	9	.7	17	.2	11
Time and materials	3.5	15	4.0	34	2.9	23	3.4	57	2.7	38	.9	25	1.5	36	1.0	52
Total	100.0	427	100.0	843	99.9	764	100.1[a]	1674	100.1[a]	1403	100.0	2895	100.1[a]	2399	100.2[a]	5145

Table 5–15. Total Number of Actions in Direct Awards to Business by Contract Pricing Provisions: Six-Month Periods (Continued)
(in thousands)

Pricing Provision	1964		1965				1966				1967				1968	
	7/1–12/31		1/1–6/30		7/1–12/31		1/1–6/30		7/1–12/31		1/1–6/30		7/1–12/31		1/1–6/30	
	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number
Incentive	4.8	227	5.4	375	6.8	341	8.8	615	10.1	497	11.5	768	15.8	645	13.1	798
Fixed price	1.0	47	.7	52	1.0	48	.9	62	1.0	47	1.5	98	1.3	52	1.3	81
Cost reimbursable	3.8	180	4.7	323	5.8	293	7.9	553	9.1	450	10.0	670	14.6	593	11.8	717
Other fixed price	53.0[a]	2529	54.0	3750	59.9	3011	53.9[a]	3774	51.1	2519	50.0	3351	51.2	2087	47.7	2903
Firm	52.7[a]	2516	54.0	3746	59.3	2979	53.8[a]	3761	50.9	2509	49.8	3335	50.8	2070	47.5	2889
Redeterminable	.2[a]	11	*	4	.1	5	.1[a]	5	.1	5	.1	8	.2	10	.1	8
Escalation	*	2	–	–	.5	27	.1[a]	8	.1	5	.1	8	.2	7	*	6
Other cost reimbursable	39.9	1905	40.1	2784	30.8[a]	1547	36.1[a]	2530	35.1	1730	37.1	2486	28.0	1142	36.8	2239
Cost-no-fee	1.0	47	2.1	143	2.1[a]	108	1.3[a]	90	2.0	100	1.0	64	.7	30	1.1	69
Cost-plus-fixed-fee	38.7	1848	37.9	2636	28.6[a]	1438	34.8[a]	2434	33.1	1629	36.0	2410	27.3	1110	35.6	2166
Cost sharing	.2	10	.1	5	*	1	.1[a]	6	*	1	.2	12	*	2	*	4
Labor hour	.2	14	.2	17	.1	5	*	3	.1	4	*	2	*	2	*	5
Time and materials	2.0	95	.3	20	2.4	120	1.2	83	3.6	175	1.4	91	4.8	197	2.3	138
Total	100.0	4770	100.0	6946	100.0	5024	100.0	7005	100.0	4925	100.0	6698	100.0	4073	99.9[a]	6083

[a] Discrepancy due to rounding.

*Less than 0.05 percent

Source: NASA, *Semiannual Procurement Report*, 1961–1967, and *Annual Procurement Report*, FY 1961–1968.

Table 5–16. Total Number of Actions in Direct Awards to Business by Contract Pricing Provisions by Fiscal Year
(in thousands)

Pricing Provision	FY 1961		FY 1962		FY 1963		FY 1964		FY 1965		FY 1966		FY 1967		FY 1968	
	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number
Incentive	0.1	1	0.4	10	1.6	68	3.1	237	5.1	602	7.9	956	10.9	1 265	14.2	1 443
Fixed price	.1	1	.2	4	.1	5	.6	48	.8	99	.9	110	1.2	145	1.3	133
Cost reimbursable	–	–	.2	6	1.5	63	2.5	189	4.3	503	7.0	846	9.6	1 120	12.9	1 310
Other fixed price	43.4	551	40.4	984	45.8[a]	1965	47.3	3565	53.6[a]	6 279	56.4	6 785	50.5	5 870	49.1	4 990
Firm	42.6	541	40.2	979	45.2[a]	1941	47.1	3550	53.4[a]	6 262	56.0	6 740	50.3	5 844	48.8	4 959
Redeterminable	.8	10	.2	5	.5[a]	22	.2	15	.1[a]	15	.1	10	.1	13	.2	18
Escalation	–	–	–	–	*	2	–	–	*	2	.3	35	.1	13	.1	13
Other cost reimbursable	52.7	669	55.8	1361	50.9	2185	48.1	3626	40.0	4 689	33.9	4 077	36.3	4 216	33.3	3 381
Cost-no-fee	.4	5	1.1	26	1.9	80	1.3	95	1.6	190	1.6	198	1.4	164	1.0	99
Cost-plus-fixed-fee	52.1	662	54.6	1332	48.8	2096	46.6	3515	38.3	4 484	32.2	3 872	34.8	4 039	32.3	3 276
Cost sharing	.2	2	.1	3	.2	9	.2	16	.1	15	.1	7	.1	13	*	6
Labor hour	–	–	.1	3	.3	14	.4	28	.3	31	.1	8	*	6	*	7
Time and materials	3.9	49	3.3	80	1.5	63	1.2	88	1.0	115	1.7	203	2.3	266	3.3	335
Total	100.1[a]	1270	100.0	2438	100.1[a]	4295	100.1[a]	7544	100.0	11 716	100.0	12 029	100.0	11 623	99.9[a]	10 156

[a] Discrepancy due to rounding.

*Less than 0.05 percent.

Source: NASA, *Annual Procurement Report*, FY 1961–1968.

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Table 5-17. Distribution of NASA Prime Contract Awards by States: FY 1961–FY 1968[a]
(thousands of dollars)

State	FY 1961 Amount	FY 1961 % of Total	FY 1962 Amount	FY 1962 % of Total	FY 1963 Amount	FY 1963 % of Total	FY 1964 Amount	FY 1964 % of Total	FY 1965 Amount	FY 1965 % of Total	FY 1966 Amount	FY 1966 % of Total	FY 1967 Amount	FY 1967 % of Total	FY 1968 Amount	FY 1968 % of Total	Total FY 1961–1968 Amount	Total FY 1961–1968 % of Total
Total	$380 176	100.0	$939 143	100.0	$2 181 405	100.0	$3 490 230	100.0	$4 103 399	100.0	$4 127 046	100.0	$3 943 466	100.0	$3 498 450	100.0	$22 663 325	100.0
Alabama	37 130	9.8	81 264	8.7	97 068	4.4	146 400	4.2	236 890	5.8	319 163	7.7	240 233	6.1	197 601	5.6	1 356 789	6.0
Alaska	675	.2	4 227	.5	2 037	.1	846	*	1 350	*	2 290	.1	439	*	225	*	12 020	.1
Arizona	402	.1	5 583	.6	6 291	.3	6 197	.2	10 836	.3	10 077	.2	7 887	.2	7 008	.2	54 281	.2
Arkansas	25	*	37	*	322	*	336	*	464	*	230	*	193	*	106	*	1 728	*
California	148 713	39.1	441 179	47.0	1 098 486	50.4	1 663 071	47.6	1 875 663	45.7	1 808 100	43.8	1 562 968	39.6	1 317 953	37.7	9 916 155	43.7
Colorado	2 567	.7	3 622	.4	7 094	.3	12 238	.4	10 292	.3	12 516	.3	20 272	.5	34 762	1.0	103 595	.5
Connecticut	3 165	.8	3 796	.4	9 003	.4	20 226	.6	25 156	.6	29 049	.7	27 980	.7	21 015	.6	138 402	.6
Delaware	45	*	34		294	*	553	*	807	*	5 121	.1	6 597	.2	8 301	.2	21 662	.1
Dist. of Col.	6 231	1.6	10 975	1.1	27 141	1.2	41 805	1.2	50 795	1.2	21 409	.5	43 100	1.1	78 869	2.3	280 320	1.2
Florida	5 063	1.3	50 925	5.4	92 391	4.2	141 568	4.1	181 696	4.4	195 840	4.8	289 210	7.3	336 598	9.6	1 293 210	5.7
Georgia	2 921	.8	3 382	.4	6 625	.3	6 416	.2	7 447	.2	4 639	.1	4 709	.1	3 487	.1	38 987	.2
Hawaii	160	*	–	–	124	*	194	*	1 237	*	3 905	.1	4 698	.1	3 024	.1	13 342	.1
Idaho	–	–	–	–	1 791	.1	139	*	132	*	141	*	36	*			2 239	*
Illinois	3 872	1.0	8 403	.9	14 837	.7	15 420	.4	18 107	.4	16 052	.4	11 690	.3	9 087	.3	97 385	.4
Indiana	1 055	.3	1 646	.2	2 920	.1	4 167	.1	6 760	.2	6 957	.2	4 578	.1	3 449	.1	31 483	.1
Iowa	679	.2	1 898	.2	2 548	.1	1 822	.1	2 223	.1	3 584	.1	3 138	.1	5 968	.2	21 856	.1
Kansas	–	–	–	–	898	*	503	*	1 866	*	1 202	*	2 901	.1	829	*	8 199	*
Kentucky	32	*	–	–	82	*	398	*	967	*	659	*	685	*	982	*	3 765	*
Louisiana	79	*	18 516	2.0	185 263	8.5	286 257	8.2	355 362	8.7	338 511	8.2	272 335	6.9	232 208	6.6	1 688 529	7.5
Maine	–	–	–	–	192	*	197	*	172	*	169	*	2 802	.1	8 535	.2	12 067	.1
Maryland	12 940	3.4	26 773	2.9	47 185	2.2	69 528	2.0	95 676	2.3	112 412	2.7	121 555	3.1	125 172	3.6	601 239	2.7
Massachusetts	8 008	2.1	19 737	2.1	43 463	2.0	78 937	2.3	62 296	1.5	71 508	1.7	72 787	1.8	79 368	2.3	435 665	1.9
Michigan	3 889	1.0	5 644	.6	9 088	.4	12 025	.3	12 420	.3	16 218	.4	38 194	.9	26 628	.8	120 109	.5
Minnesota	1 825	.5	2 927	.3	8 583	.4	23 607	.7	45 060	1.1	23 705	.6	21 294	.5	25 021	.7	149 086	.7
Mississippi	–	–	93	*	86	*	609	*	4 300	.1	5 025	.1	3 638	.1	1 667	*	15 428	.1
Missouri	42 429	11.2	70 600	7.5	197 106	9.0	272 022	7.8	171 078	4.2	55 229	1.3	11 556	.3	10 922	.3	830 937	3.7
Montana	–	–	–	–	70	–	161	*	276	*	471	*	100	*	225	*	1 308	*
Nebraska	–	–	–	–	–	–	156	*	233	*	168	*	78	*	182	*	677	*
Nevada	50	*	435	*	484	*	441	*	229	*	168	*	230	*	257	*	2 306	*
New Hampshire	29	*	320	*	585	*	1 103	*	7 002	.2	5 960	.1	7 037	.2	6 991	.2	28 937	.1
New Jersey	11 893	3.1	26 980	2.9	55 889	2.6	62 918	1.8	113 435	2.8	67 368	1.6	82 725	2.1	72 777	2.1	493 980	2.2
New Mexico	1 302	.3	1 696	.2	2 916	.1	3 432	.1	7 703	.2	14 296	.4	11 552	.3	12 476	.4	55 373	.2
New York	43 872	11.5	55 301	5.9	97 471	4.5	251 099	7.2	348 113	8.4	464 085	11.3	555 609	14.1	443 967	12.7	2 256 887	10.0
North Carolina	136	*	1 695	.2	1 000	*	3 136	.1	2 023	.1	2 398	.1	1 980	.1	1 568	*	13 927	.1
North Dakota	–	–	–	–	–	–	38	*	74	*	96	*	100	*	17	*	325	*
Ohio	8 136	2.1	11 320	1.2	32 268	1.5	52 193	1.5	53 013	1.3	43 180	1.1	32 473	.8	27 669	.8	260 196	1.1
Oklahoma	337	.1	687	*	1 087	.1	1 877	.1	6 534	.2	2 508	.1	1 195	*	907	*	15 132	0.1
Oregon	200	.1	33	*	575	*	868	*	549	*	893	*	860	*	536	*	4 614	*
Pennsylvania	11 443	3.0	25 291	2.7	30 489	1.4	51 806	1.5	59 313	1.5	60 896	1.5	62 525	1.6	55 317	1.6	358 274	1.6
Rhode Island	83	*	243	*	356	*	641	*	1 608	*	976	*	875	*	366	*	5 326	*
South Carolina	–	–	–	–	76	*	256	*	345	*	262	*	218	*	109	*	1 209	*
South Dakota	–	–	98	*	407	*	168	*	63	*	85	*	69	*	113	*	1 003	*
Tennessee	949	.2	2 103	.2	2 300	.1	2 490	.1	1 789	*	1 892	.1	1 593	*	964	*	14 183	.1
Texas	12 180	3.2	32 755	3.5	54 772	2.5	148 735	4.3	149 615	3.6	170 123	4.1	258 128	6.5	234 515	6.7	1 060 620	4.7
Utah	28	*	37	*	534	*	471	*	435	*	736	*	1 720	*	1 879	0.1	5 877	*
Vermont	–	–	112	*	128	*	96	*	654	*	290	*	357	*	408	*	1 925	*
Virginia	6 850	1.8	13 785	1.5	23 961	1.1	29 469	.8	42 801	1.0	37 584	.9	43 734	1.1	36 491	1.0	236 599	1.0
Washington	99	*	325	*	2 516	.1	27 334	.8	54 679	1.3	61 169	1.5	32 224	.8	16 364	.5	196 730	.9
West Virginia	–	–	–	–	538	*	939	*	575	*	351	*	320	*	180	*	3 044	*
Wisconsin	705	.2	4 618	.5	12 683	.6	45 042	1.3	77 279	1.9	126 576	3.1	75 073	1.9	47 786	1.4	389 770	1.7
Wyoming	–	–	–	–	38	*	114	*	263	*	115	*	143	*	35	*	708	*

[a] Includes awards on R&D contracts and awards to educational and nonprofit institutions of $10 000 and over and all other contracts of $25 000 and over; excludes awards placed through other Government agencies, awards outside the U.S., and actions on the Jet Propulsion Laboratory contracts.

*Less than 0.05 percent.

Source: NASA, *Annual Procurement Report, FY 1968*, p. 79.

Table 5-18. Distribution of NASA Prime Contract Awards by U.S. Region: FY 1964-FY 1968[a]

Region	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	Total FY 1964-1968
	Net Value of Awards (Millions of Dollars)					
Total	$3490	$4104	$4127	$3943	$3498	$19 162
New England	101	97	107	112	116	533
Mideast	478	664	733	872	784	3 531
Southeast	618	835	907	860	812	4 032
Great Lakes	129	167	209	158	115	778
Plains	298	221	84	39	41	683
Southwest	160	175	197	279	255	1 066
Rocky Mountain	13	11	14	22	37	97
Far West	1692	1931	1870	1596	1335	8 424
Alaska & Hawaii	1	3	6	5	3	18
	Percent of Total					
Total	100	100	100	100	100	100
New England	3	2	3	3	3	3
Mideast	14	16	18	22	23	18
Southeast	18	21	22	22	24	21
Great Lakes	4	4	5	4	3	4
Plains	8	6	2	1	1	4
Southwest	5	4	5	7	7	6
Rocky Mountain	*	*	*	1	1	*
Far West	48	47	45	40	38	44
Alaska & Hawaii	*	*	*	*	*	*
	Percent Increase (Decrease) Over Previous Year					
Total	60	18	1	(5)	(11)	
New England	91	(4)	10	5	4	
Mideast	85	39	10	19	(10)	
Southeast	51	35	9	(5)	(6)	
Great Lakes	82	29	25	(24)	(27)	
Plains	43	(26)	(62)	(54)	5	
Southwest	146	9	13	42	(9)	
Rocky Mountain	30	(15)	27	57	68	
Far West	53	14	(3)	(15)	(16)	
Alaska & Hawaii	(50)	200	100	(17)	(40)	

[a] Includes awards on R&D contracts and awards to educational and nonprofit institutions of $10 000 and over and on all other contracts of $25 000 and over; excludes awards placed through other Government agencies, awards outside the U.S., and actions on the JPL contracts.

*Less than 0.5 percent.

Source: NASA, *Annual Procurement Report, FY 1968*, p. 54.

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Table 5-19. Value of Awards by Installation
(in millions)

Installation	FY 1960		FY 1961		FY 1962		FY 1963		FY 1964		FY 1965		FY 1966		FY 1967		FY 1968	
	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount
Headquarters	34	$116.1	3	$ 25.3	4	$ 67.7	5	$ 155.1	4	$ 189.0	4	$ 209.0	4	$ 187.1	4	$ 168.9	11	$ 436.1
Ames Research Center	2	7.7	2	11.0	1	14.4	1	28.0	1	47.9	2	80.9	2	77.3	2	86.3	2	78.5
Electronics Research Center	–	–	–	–	–	–	–	–	–	–	*	4.0	*	14.7	*	21.7	1	50.6
Flight Research Center	1	2.0	*	1.3	*	2.5	1	18.3	*	13.7	*	14.7	*	15.4	*	25.5	*	26.2
Goddard Space Flight Center	23	76.0	21	155.0	14	209.3	9	303.5	8	382.8	10	517.7	9	473.8	9	398.9	11	471.0
Kennedy Spacecraft Center	–	–	–	–	2	36.9	7	232.0	6	261.3	5	287.2	6	292.6	8	375.0	10	414.2
Langley Research Center	35	118.5	9	66.9	5	70.8	2	83.4	2	103.9	3	130.8	3	139.6	3	142.7	3	103.6
Lewis Research Center	5	17.2	3	24.0	2	34.5	7	214.7	8	347.4	6	324.2	5	262.0	5	214.8	4	152.9
Manned Spacecraft Center	–	–	11	82.1	13	204.8	23	737.2	31	1436.0	29	1487.4	31	1546.7	32	1487.0	30	1233.1
Marshall Space Flight Center	–	–	34	257.8	39	595.6	29	949.8	30	1378.1	32	1689.9	31	1587.3	28	1304.9	26	1088.3
Space Nuclear Propulsion Office	–	–	–	–	2	36.4	3	84.3	2	91.7	2	79.7	2	85.8	2	85.2	2	65.7
Wallops Station	–	–	*	1.5	1	11.0	*	11.9	*	13.0	*	15.4	*	12.1	*	12.7	*	12.5
Pacific Launch Operations Office	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Western Support Office	–	-0.9	17	130.6	17	266.7	13	412.3	7	329.1	7	346.5	–	–	–	–	–	–
NASA Pasadena	–	–	–	–	–	–	–	–	–	–	–	–	7	337.2	7	327.3	–	–
Total	100	$336.7	100	$755.5	100	$1550.6	100	$3230.5	100	$4593.9	100	$5187.4	100	$5031.6	100	$4650.9	100	$4132.7

* = Less than 0.05%.

Source: NASA, *NASA Procurement*, 1958–1960, and *Annual Procurement Report*, FY 1961–1968.

Table 5-20. NASA's Active Prime Contracts of $25 Million and Over
(contracts under which work was being performed as of June 30, 1968)

Contractor	Contract Description	Procuring Installation	Contract Number	Fy 1968 Obligations (thousands)	Cumulative Obligations (thousands)
North American Rockwell Corp. Space Division	Design, develop and test Apollo command and service module	Manned	NAS 9-150	$418 741	$3 015 128
Grumman Aircraft Engineering Corp.	Development of Apollo lunar module	Manned	NAS 9-1100	357 946	1 582 707
Boeing Co. Aerospace Division	Design, develop and fabricate S-IC stage of Saturn V vehicle; construct facilities in support of S-IC and provide launch support services	Marshall Kennedy	NAS 8-5608	234 083	1 198 790
North American Rockwell Corp. Space Division	Design, develop, fabricate and test S-II stage of Saturn V vehicle and provide launch support services	Marshall Kennedy	NAS 7-200	211 581	1 129 389
McDonnell Douglas Co. Missile & Space Division	Design, develop and fabricate S-IVB stage of Saturn V vehicle and associated ground support equipment and provide launch support services	Marshall Kennedy	NAS 7-101	163 859	958 752
General Electric Co. Command Systems Division	Apollo checkout equipment, related engineering design, quality and data management and engineering support; support services to Mississippi Test Facility	Headquarters Manned Marshall Kennedy	NASW 410	136 928	669 694
North American Rockwell Corp. Rocketdyne Division	Develop and procure 200 000-pound-thrust J-2 rocket engine with supporting services and hardware	Marshall	NAS 8-19	82 367	611 498
Chrysler Corp. Space Division	Fabricate, assemble, check out and static test Saturn S-IB stage; provide product improvement program and spare parts support; modify areas of Michoud plant assigned to contractor; provide launch support services	Marshall Kennedy	NAS 8-4016	61 252	457 289
Aerojet-General Corp.	Design, develop and produce nuclear-powered rocket engine (NERVA)	SNPC	SNP-1	52 631	450 187
General Motors Corp. AC Electronics Division	Guidance computer subsystem for Apollo command service module	Manned	NAS 9-497	45 825	340 978
General Dynamics Corp. Convair Division	Develop, fabricate and deliver Centaur vehicles and support equipment	Lewis	NAS 3-3232	1 289	305 869

Table 5-20. NASA's Active Prime Contracts of $25 Million and Over (Continued)
(contracts under which work was being performed as of June 30, 1968)

Contractor	Contract Description	Procuring Installation	Contract Number	FY 1968 Obligations (thousands)	Cumulative Obligations (thousands)
International Business Machines Corp. Federal Systems Division	Fabrication, assembly and checkout of instrument units for Saturn I and V vehicles	Marshall Kennedy	NAS 8-14000	$ 84 853	$ 266 086
North American Rockwell Corp. Rocketdyne Division	Fabrication and delivery of F-1 engines; provide supporting services and hardware	Marshall	NAS 8-5604	12 635	238 742
Boeing Co., Aerospace Division	Develop and fabricate Lunar Orbiter spacecraft systems	Langley	NAS 1-3800	7 458	152 708
Philco-Ford Corp. Western Develop. Lab.	Equipment and construction of facilities for integrated mission control center at Manned Spacecraft Center	Manned	NAS 9-1261	22 352	123 047
Grumman Aircraft Engineering Corp.	Design, develop, fabricate and test Orbiting Astronomical Observatories	Goddard	NAS 5-814	9 849	120 202
International Business Machines Corp. Federal Systems Division	Design, develop and implement real-time computer complex for integrated mission control center at Manned Spacecraft Center	Manned	NAS 9-996	24 570	113 516
North American Rockwell Corp. Rocketdyne Division	Fabrication and delivery of F-1 engines; provide supporting services and hardware	Marshall	NAS 8-18734	67 490	104 395
Trans World Airlines	Provide base support services at Kennedy Space Center	Kennedy	NAS 10-1242	24 587	82 002
General Electric Co. Missile & Space Division	Design, fabricate, deliver and provide operational support for Biosatellites	Ames	NAS 2-1900	21 000	81 003
Bendix Corp. Field Engineering Corp.	Apollo launch support services at Kennedy Space Center	Kennedy	NAS 10-1600	33 136	75 800
TRW Inc. TRW Systems Group	Gemini-Apollo mission trajectory and Apollo spacecraft systems analysis program	Manned	NAS 9-4810	25 650	71 966
Aerojet-General Corp.	Development of nuclear power conversion system designed and tested to sustain launch, orbital startup and shutdown	Lewis	NAS 5-417	6 732	70 127

Table 5–20. NASA's Active Prime Contracts of $25 Million and Over (Continued)
(contracts under which work was being performed as of June 30, 1968)

Contractor	Contract Description	Procuring Installation	Contract Number	FY 1968 Obligations (thousands)	Cumulative Obligations (thousands)
International Business Machines Corp. Federal Systems Division	Launch vehicle digital computers, data adapters and associated hardware for Saturn IB and Saturn V vehicles	Marshall	NAS 8–11562	$ 8 683	$ 61 331
Hughes Aircraft Co. Aerospace Group	Develop and test Applications Technology Satellite	Goddard	NAS 5–3823	7 003	60 047
Bendix Corp. Navigation & Control Division	Stabilized platform systems and associated hardware for Saturn IB and Saturn V vehicles	Marshall	NAS 8–13005	10 868	57 557
Bellcomm, Inc.	Systems analysis, study, planning and technical support for manned space-flight programs	Headquarters	NASW 417	10 000	54 232
General Electric Co. Missile & Space Division	Design, develop, fabricate and test Nimbus spacecraft	Goddard	NAS 5–978	5 775	53 996
Boeing Co.	Apollo/Saturn V technical integration and evaluation	Headquarters	NASW 1650	43 323	52 296
Bendix Corp. Field Engineering Corp.	Operation, maintenance and support services for Manned Space Flight Tracking and Data Acquisition Network	Goddard	NAS 5–9870	693	51 868
Bendix Corp. Aerospace Systems Division	Apollo lunar surface experiments package	Manned	NAS 9–5829	19 836	50 876
TRW Inc. TRW Systems Group	Design, develop, fabricate and test Orbiting Geophysical Observatories	Goddard	NAS 5–3900	16 153	50 483
Catalytic Construction Co.	Management services, fabrication, installation and checkout of propellant servicing systems. Saturn Launch Complex No. 39A	Kennedy	NAS 10–1138	2 470	49 329
Union Carbide Corp. Linde Co.	Liquid hydrogen, lease of trailers and transportation costs	Pasadena	NASW 452	14 092	47 727
Brown Engineering Co.	Engineering, operation and fabrication services in support of the propulsion and vehicle engineering laboratory, Marshall Space Flight Center	Marshall	NAS 8–20073	14 090	46 850

Table 5–20. NASA's Active Prime Contracts of $25 Million and Over (Continued)
(contracts under which work was being performed as of June 30, 1968)

Contractor	Contract Description	Procuring Installation	Contract Number	FY 1968 Obligations (thousands)	Cumulative Obligations (thousands)
North American Rockwell Corp. Rocketdyne Division	Design, develop and fabricate H–1 liquid-propellant rocket engine	Marshall	NAS 7–190	$ 1 460	$ 44 010
Collins Radio Co. Dallas Division	Design and fabricate S-band tracking data equipment and space components for Project Apollo	Goddard	NAS 5–9035	1 388	43 994
United Aircraft Corp. Hamilton Standard Division	Development of Apollo prototype space suits and portable life support systems	Manned	NAS 9–3535	9 607	42 019
Radio Corp. of America Service Co.	Operation and maintenance of DAF stations and support services for DAF network	Goddard	NAS 5–3480	13 614	41 296
Mason-Rust	Support services for Saturn IB and Saturn V vehicles	Marshall	NAS 8–14017	12 345	39 370
Sperry Rand Corp. Space Support Division	Engineering, operation and fabrication services in support of Astronics Laboratory, Marshall Space Flight Center	Marshall	NAS 8–20055	10 286	38 912
General Dynamics Corp. Convair Division	Management and engineering services in support of Centaur program	Lewis	NAS 3–8711	24 340	38 475
Bendix Corp. Field Engineering Corp.	Operation, maintenance and logistic support of Space Tracking and Data Acquisition Network	Goddard	NAS 5–9968	11 382	36 633
LTV Aerospace Corp. LTV Range Systems Division	Provide administrative and management services at Kennedy Space Center	Kennedy	NAS 10–1113	10 057	35 918
TRW Inc., TRW Systems Group	Design, develop, fabricate and test Pioneer spacecraft	Ames	NAS 2–1700	2 013	34 843
North American Rockwell Corp. Rocketdyne Division	Provide industrial facilities for Saturn IB and Saturn V vehicles	Marshall	NAS 8–5609	–757	34 692
North American Rockwell Corp. Rocketdyne Division	Production of H–1 liquid propellant rocket engine and supporting supplies and services	Marshall	NAS 7–162	100	31 813

Table 5-20. NASA's Active Prime Contracts of $25 Million and Over (Continued)
(contracts under which work was being performed as of June 30, 1968)

Contractor	Contract Description	Procuring Installation	Contract Number	Fy 1968 Obligations (thousands)	Cumulative Obligations (thousands)
Sperry Rand Corp. Univac Division	Digital data processing systems for Project Apollo including related documentation and support services	Goddard	NAS 5-9816	$ 1 271	$ 30 146
Lockheed Aircraft Corp. Electronics Co.	General electronics, instrumentation, and engineering support services for Apollo spacecraft	Manned	NAS 9-5191	14 757	29 965
Air Products & Chemicals, Inc.	Liquid hydrogen	Pasadena	NASW 352	590	28 313
Boeing Co., Aerospace Division	Facilities for Saturn V S-IC stage program	Marshall	NAS 8-5606	930	28 023
Bendix Corp. Field Engineering Corp.	Maintenance and operation of Manned Space Flight Network	Goddard	NAS 5-10750	27 089	27 089

Source: NASA, Office of Industry Affairs, Procurement Office, *NASA Procurement Program Policies and Trends Handbook* (PATH) (Washington, D.C.: NASA, October 1968), pp. D-1 to D-9.

Table 5-21. Ranking of NASA's Top Ten Contractors

Contractor	FY 1962	FY 1963	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968
North American Rockwell Corp.[a]	1	1	1	1	1	1	1
McDonnell Aircraft Co., Inc.[b]	2	2	2	6	4	4	4
Douglas Aircraft Co., Inc.[b]	3	4	3	4	–	–	–
Aerojet-General Corp.	4	3	8	8	8	8	8
United Aircraft Co.	5	9	–	–	–	–	–
Chrysler Corp.	6	7	9	–	10	9	10
General Dynamics Corp.	7	5	6	9	9	–	–
Ling-Temco-Vought, Inc.	8	–	–	–	–	–	–
Grumman Aircraft Engineering Corp.	9	10	5	3	2	2	2
General Electric Co.	10	8	7	5	5	6	5
Boeing Co.	–	6	4	2	3	3	3
International Business Machines Corp.	–	–	10	7	7	5	6
Radio Corp. of America	–	–	–	10	–	–	9
Bendix Corp.	–	–	–	–	–	7	7
General Motors Corp.	–	–	–	–	6	10	–

[a] North American Aviation, inc. until FY 1967.

[b] Merged to form McDonnell Douglas Corporation.

Source: NASA, *Annual Procurement Report*, FY 1962–1968.

Table 5-22. Top One Hundred Contractors: FY 1963

	Contractor and Place of Contract Performance[a]	Rank in FY 1962	Net Value of Awards[b]	
			Thousands of Dollars	Percentage of Total
	Total Awards to Business		*2 261 600*	*100.0*
1.	North American Aviation, Inc. Canoga Park, Calif.	1	525 806	23.2
2.	McDonnell Aircraft Corp. St. Louis, Mo.	2	193 052	8.5
3.	Aerojet-General Corp. Azusa, Calif.	4	160 483	7.1
4.	Douglas Aircraft Co., Inc. Santa Monica, Calif.	3	133 006	5.9
5.	General Dynamics Corp. San Diego, Calif.	7	103 118	4.6
6.	Boeing Co. Seattle, Wash.	13	101 031	4.5
7.	Chrysler Corp. Detroit, Mich.	6	75 416	3.3
8.	General Electric Co. Philadelphia, Pa.	10	52 957	2.3
9.	United Aircraft Co. Windsor Locks, Conn.	5	48 879	2.2
10.	Grumman Aircraft Engineering Corp. Bethpage, N.Y.	9	48 197	2.1
11.	Radio Corporation of America Princeton, N.J.	11	42 169	1.9
12.	International Business Machines Corp. Rockville, Md.	15	36 135	1.6
13.	Bendix Corp. Teterboro, N.J.	12	32 517	1.4
14.	Space Technology Laboratories, Inc. Redondo Beach, Calif.	14	32 510	1.4
15.	Ling-Temco-Vought, Inc. Dallas, Tex.	8	26 722	1.2
16.	Brown Engineering Co. Huntsville, Ala.	16	24 104	1.1
17.	Lockheed Aircraft Corp. Sunnyvale, Calif.	21	23 656	1.0
18.	Hughes Aircraft Co. Culver City, Calif.	18	18 317	.8
19.	Mason-Rust Lexington, Ky.	62	16 406	.7
20.	Hayes International Corp. Birmingham, Ala.	17	15 433	.7
21.	Philco Corp. Palo Alto, Calif.	26	14 864	.7
22.	Union Carbide Corp. Fontana, Calif.	25	12 747	.6
23.	Lear-Siegler, Inc. Anaheim, Calif.	–	11 582	.5
24.	General Motors Corp. Indianapolis, Indiana	59	10 170	.4
25.	Republic Aviation Corp. Farmingdale, N.Y.	20	9 273	.4
26.	Universal Marion Corp. Marion, Ohio	–	8 999	.4
27.	Martin Marietta Corp. Baltimore, Md.	47	7 173	.3
28.	Raytheon Co. Bedford, Mass.	–	7 141	.3
29.	Norair Engineering Corp. Washington, D.C.	100	7 072	.3
30.	Electro-Mechanical Research, Inc. Sarasota, Fla.	79	6 821	.3
31.	Bellcomm, Inc. Washington, D.C.	–	6 355	.3
32.	Fairchild Stratos Corp. Hagerstown, Md.	–	6 241	.3
33.	Catalytic Construction Co. Philadelphia, Pa.	–	5 850	.3
34.	Kollsman Instrument Corp. Elmhurst, N.Y.	70	5 061	.2
35.	Radiation Inc. Melbourne, Fla.	37	4 874	.2
36.	Collins Radio Company Cedar Rapids, Iowa	31	4 599	.2
37.	Federal Mogul Bower Bearings, Inc. Los Alamitos, Calif.	46	4 281	.2

Table 5-22. Top One Hundred Contractors: FY 1963 (Continued)

	Contractor and Place of Contract Performance[a]		Rank in FY 1962	Net Value of Awards[b]	
				Thousands of Dollars	Percentage of Total
38.	Air Products & Chemicals Inc. Allentown, Pa.		35	3 893	.2
39.	Westinghouse Electric Corp. Baltimore, Md.		34	3 820	.2
40.	Ampex Corp. Huntsville, Ala.		44	3 765	.2
41.	Avco Corp. Wilmington, Mass.		57	3 700	.2
42.	Thiokol Chemical Corp. Elkton, Md.		98	3 690	.2
43.	Telecomputing Corp. San Diego, Calif.		82	3 632	.2
44.	Sullivan Long & Hagerty Birmingham, Ala.		–	3 515	.2
45.	Documentation Inc. Bethesda, Md.	(S)	67	3 416	.2
46.	Spaco Inc. Huntsville, Ala.	(S)	56	3 374	.1
47.	Sperry Rand Corp. Great Neck, N.Y.		41	3 210	.1
48.	Minneapolis Honeywell Regulator Co. Minneapolis, Minn.		23	3 175	.1
49.	Bell Aerospace Corp. Buffalo, N.Y.		–	3 096	.1
50.	Motorola Inc. Scottsdale, Arizona		22	3 057	.1
51.	Roediger Construction Inc. Cleveland, Ohio		–	3 000	.1
52.	Algernon Blair, Inc. Montgomery, Ala.	(S)	52	2 952	.1
53.	Garrett Corp. Los Angeles, Calif.		–	2 937	.1
54.	Packard Bell Electronics Corp. Los Angeles, Calif.		24	2 777	.1
55.	Swenson, Carl N., Co. San Jose, Calif.		–	2 743	.1
56.	American Telephone & Telegraph Co. Washington, D.C.		42	2 697	.1
57.	Calumet & Hecla, Inc. Bartlett, Ill.		33	2 687	.1
58.	Pearce & Gresham Co. Decatur, Ill.	(S)	–	2 673	.1
59.	Ball Bros. Research Corp. Boulder, Colorado		39	2 593	.1
60.	Thompson-Ramo-Wooldridge Inc. Cleveland, Ohio		36	2 556	.1
61.	Control Data Corp. Minneapolis, Minn.		–	2 457	.1
62.	Piracci Construction Co. Inc. Baltimore, Md.	(S)	–	2 422	.1
63.	Doyle & Russell Inc. Norfolk, Va.		45	2 273	.1
64.	Noble Co. Oakland, Calif.	(S)	95	2 227	.1
65.	Vitro Corp. of America Silver Spring, Md.		50	2 187	.1
66.	Kaiser Engineers Oakland, Calif.		–	2 144	.1
67.	Electronic Associates, Inc. Long Branch, N.J.		69	2 045	.1
68.	Northrop Corp. Hawthorne, Calif.		63	1 956	.1
69.	Western Electric Inc. New York, N.Y.		19	1 930	.1
70.	Sverdrup & Parcel & Associates, Inc. St. Louis, Mo.		53	1 928	.1
71.	Canoga Electronics Corp. Van Nuys, Calif.	(S)	–	1 897	.1
72.	Consolidated Electrodynamics Corp. Arlington, Va.		73	1 764	.1
73.	Spacecraft, Inc. Huntsville, Ala.	(S)	–	1 762	.1
74.	Wyle Laboratories Huntsville, Ala.	(S)	–	1 696	.1
75.	Scientific Data Systems Santa Monica, Calif.	(S)	–	1 639	.1

Table 5-22. Top One Hundred Contractors: FY 1963 (Continued)

Contractor and Place of Contract Performance[a]		Rank in FY 1962	Net Value of Awards[b] Thousands of Dollars	Net Value of Awards[b] Percentage of Total
76. American Machine & Foundry Co. Stamford, Conn.		–	1 617	.1
77. Beech Aircraft Corp. Boulder, Colo.		–	1 586	.1
78. Consolidated Systems, Corp. Monrovia, Calif.		48	1 520	.1
79. Textron, Inc. Belmont, Calif.		–	1 504	.1
80. Management Services Inc. Oak Ridge, Tenn.	(S)	43	1 496	.1
81. Rohr Corp. Chula Vista, Calif.		71	1 473	.1
82. Space-General Corp. El Monte, Calif.		83	1 448	.1
83. Electronic Communications Inc. St. Petersburg, Fla.		–	1 440	.1
84. Electro Optical System Inc. Pasadena, Calif.	(S)	87	1 397	.1
85. Textron Electronics Inc. Cumberland, Md.		–	1 336	.1
86. Pacific Gas & Electric Co. San Francisco, Calif.		–	1 320	.1
87. Federal Service Inc. Washington, D.C.		–	1 320	.1
88. Ryan Aeronautical Co. San Diego, Calif.		–	1 303	.1
89. International Telephone & Telegraph Corp. Ft. Wayne, Indiana		40	1 302	.1
90. Progressive Welder & Machine Co. Pontiac, Mich.	(S)	38	1 266	.1
91. Computer Control Corp. Framingham, Mass.	(S)	–	1 253	.1
92. Bechtel Corp. San Francisco, Calif.		78	1 249	.1
93. Alco Products Inc. Schenectady, N.Y.		–	1 243	.1
94. Schreimsher J. T. Construction Co. Huntsville, Ala.	(S)	66	1 243	.1
95. California Computer Products Inc. Anaheim, Calif.	(S)	92	1 230	.1
96. Minnesota Mining & Mfg. Co. Los Angeles, Calif.		84	1 186	.1
97. Gulton Industries Inc. Metuchen, N.J.		98	1 174	.1
98. Quiller Construction Co., Inc. Los Angeles, Calif.	(S)	–	1 164	.1
99. McDonough Construction Co. Atlanta, Ga.		–	1 151	.1
100. Geophysics Corp of America Bedford, Mass.	(S)	68	1 149	.1
Other			281 927	11.5

[a] Awards during year include awards on several contracts which have different principal places of performance. The place shown is that which has the largest amount of awards.

[b] Data for individual companies include awards on R&D contracts of $10 000 and over and on all other contracts of $25 000 and over.

Source: NASA, *Annual Procurement Report*, FY 1963.

(S) Indicates small business.

Table 5-23. Top One Hundred Contractors: FY 1964

	Contractor and Place of Contract Performance[a]	Rank in FY 1963	Net Value of Awards[b]	
			Thousands of Dollars	Percentage of Total
	Total Awards to Business		*3 521 095*	*100.00*
1.	North American Aviation, Inc. Downey, Calif.	1	917 244	26.05
2.	McDonnell Aircraft Corp. St. Louis, Mo.	2	267 623	7.60
3.	Douglas Aircraft Co., Inc. Santa Monica, Calif.	4	250 306	7.11
4.	Boeing Co. New Orleans, La.	6	197 067	5.60
5.	Grumman Aircraft Engineering Corp. Bethpage, N.Y.	10	156 393	4.44
6.	General Dynamics Corp. San Diego, Calif.	5	148 200	4.21
7.	General Electric Co. Daytona Beach, Fla.	8	143 562	4.08
8.	Aerojet-General Corp. Sacramento, Calif.	3	135 776	3.86
9.	Chrysler Corp. New Orleans, La.	7	99 414	2.82
10.	International Business Machines Corp. Rockville, Md.	12	85 627	2.43
11.	Radio Corporation of America Princeton, N.J.	11	49 815	1.42
12.	Bendix Corp. Owings Mills, Md.	13	41 886	1.19
13.	General Motors Corp. Milwaukee, Wis.	24	41 886	1.19
14.	Brown Engineering Co., Inc. Huntsville, Ala.	16	41 566	1.18
15.	Lockheed Aircraft Corp. Sunnyvale, Calif.	17	39 019	1.11
16.	Thompson-Ramo-Wooldridge Inc. Redondo Beach, Calif.	c	38 995	1.11
17.	United Aircraft Corp. West Palm Beach, Fla.	9	36 729	1.04
18.	Philco Corp. Palo Alto, Calif.	21	35 690	1.01
19.	Raytheon Co. Bedford, Mass.	28	23 422	.67
20.	Ling-Temco-Vought, Inc. Dallas, Tex.	15	21 545	.61
21.	Union Carbide Corp. Fontana, Calif.	22	20 100	.57
22.	Hayes International Corp. Birmingham, Ala.	20	18 715	.53
23.	Blount Brothers Construction Co. Montgomery, Ala.	–	17 005	.48
24.	Control Data Corp. Minneapolis, Minn.	61	16 940	.48
25.	Hughes Aircraft Co. Culver City, Calif.	18	14 907	.42
26.	Kollsman Instrument Corp. Elmhurst, N.Y.	34	13 584	.39
27.	Mason-Rust Lexington, Ky.	19	11 916	.34
28.	Sperry Rand Corp. Great Neck, N.Y.	47	11 797	.34
29.	Ingalls Iron Works Co. Birmingham, Ala.	–	11 385	.32
30.	Radiation, Inc. Melbourne, Fla.	35	10 797	.31
31.	Fairchild Stratos Corp. Hagerstown, Md.	32	10 412	.30
32.	Federal-Mogul-Bower Bearings, Inc. Los Alamitos, Calif.	37	10 337	.29
33.	Air Products & Chemicals, Inc. Allentown, Pa.	38	10 020	.28
34.	Ernst/Smith Joint Venture Orlando, Fla.	–	9 847	.28
35.	Republic Aviation Corp. Farmingdale, N.Y.	25	9 286	.26
36.	Northrop Corp. Hawthorne, Calif.	68	9 187	.26
37.	Bellcomm, Inc. Washington, D.C.	31	8 670	.25

Table 5-23. Top One Hundred Contractors: FY 1964 (Continued)

	Contractor and Place of Contract Performance[a]		Rank in FY 1963	Net Value of Awards[b]	
				Thousands of Dollars	Percentage of Total
38.	Martin Marietta Corp. Baltimore, Md.		27	8 452	.24
39.	Documentation, Inc. Bethesda, Md.	(S)	45	7 312	.21
40.	Honeywell, Inc. St. Petersburg, Fla.		48	7 100	.20
41.	Jones, J. A. Construction Co. New Orleans, La.		–	6 641	.19
42.	Genisco Technology Corp. Compton, Calif.	(S)	–	6 576	.19
43.	Ball Brothers Research Corp. Boulder, Colorado		59	5 976	.17
44.	Catalytic Construction Co. Philadelphia, Pa.		33	5 931	.17
45.	Westinghouse Electric Corp. Baltimore, Md.		39	5 900	.17
46.	Spaco, Inc. Huntsville, Ala.	(S)	46	5 708	.16
47.	Electro-Mechanical Research Inc. Washington, D.C.		30	5 433	.15
48.	Ampex Corp. Redwood City, Calif.		40	5 200	.15
49.	Bell Aerospace Corp. Buffalo, N.Y.		49	5 132	.15
50.	Sullivan, Long & Hagerty Birmingham, Ala.		44	4 950	.14
51.	Collins Radio Co. Dallas, Tex.		36	4 939	.14
52.	Avco Corp. Cincinnati, Ohio		41	4 898	.14
53.	Scientific Data Systems Santa Monica, Calif.	(S)	75	4 877	.14
54.	Bechtel Corp. San Francisco, Calif.		92	4 737	.13
55.	Pearce & Gresham Co. Decatur, Ala.	(S)	58	4 536	.13
56.	American Telephone & Telegraph Co. Washington, D.C.		56	4 499	.13
57.	Garrett Corp. Phoenix, Ariz.		53	4 256	.12
58.	Consolidated Electrodynamics Corp. Pasadena, Calif.		72	3 978	.11
59.	Wyle Laboratories Huntsville, Ala.		74	3 771	.11
60.	Venneri, Arthur, Co. Westfield, N.J.		–	3 521	.10
61.	Hercules Powder Co. Wilmington, Del.		–	3 479	.10
62.	Chicago Bridge & Iron Co. Cleveland, Ohio		–	3 205	.09
63.	Electronic Associates, Inc. Long Branch, N.J.		67	3 205	.09
64.	Space-General Corp. El Monte, Calif.		82	3 184	.09
65.	Basic Construction Co. Newport News, Va.		–	3 176	.09
66.	American Machine & Foundry Co. Stamford, Conn.		76	2 963	.08
67.	Graham, Wm. J. & Son Golden Beach, Fla.	(S)	–	2 957	.08
68.	Huber, Hunt & Nichols Sunnyvale, Calif.		–	2 851	.08
69.	Thiokol Chemical Corp. Denville, N.J.		42	2 792	.08
70.	Doyle & Russell, Inc. Norfolk, Va.		63	2 628	.07
71.	International Telephone & Telegraph Corp. Nutley, N.J.		89	2 601	.07
72.	Vitro Corp. of America Ft. Walton Beach, Fla.		65	2 496	.07
73.	Lear Siegler, Inc. Santa Monica, Calif.		23	2 483	.07
74.	Management Services, Inc. Oak Ridge, Tenn.	(S)	80	2 444	.07

Table 5-23. Top One Hundred Contractors: FY 1964 (Continued)

	Contractor and Place of Contract Performance[a]		Rank in FY 1963	Net Value of Awards[b]	
				Thousands of Dollars	Percentage of Total
75.	Data Control Systems, Inc. Danbury, Conn.	(S)	–	2 379	.07
76.	Motorola, Inc. Scottsdale, Ariz.		50	2 310	.07
77.	Beckman Instruments, Inc. Richmond, Calif.		–	2 304	.07
78.	Geophysics Corp. of America Bedford, Mass.	(S)	100	2 242	.06
79.	Gulton Industries, Inc. Hawthorne, Calif.		97	2 230	.06
80.	Blaw-Knox Co. Pittsburgh, Pa.		–	2 043	.06
81.	Consolidated Systems Corp. Monrovia, Calif.		78	1 953	.06
82.	Perkin-Elmer Corp., The Norwalk, Conn.		–	1 942	.06
83.	Whittaker Corp. Van Nuys, Calif.		43	1 887	.05
84.	Electro Optical Systems, Inc. Pasadena, Calif.		84	1 808	.05
85.	Aluminum Co. of America Rome, N.Y.		–	1 765	.05
86.	Goodyear Aerospace Corp. Akron, Ohio		–	1 648	.05
87.	Space Craft, Inc. Huntsville, Ala.	(S)	73	1 589	.05
88.	American Science & Engineering, Inc. Cambridge, Mass.	(S)	–	1 576	.04
89.	Systems Engineering Labs., Inc. Fort Lauderdale, Fla.	(S)	–	1 575	.04
90.	Memorex Corp. Santa Clara, Calif.	(S)	–	1 556	.04
91.	Zia Company, The Los Alamos, N. Mex.		–	1 527	.04
92.	Textron Electronics, Inc. New Haven, Conn.		85	1 516	.04
93.	Xerox Corp. Birmingham, Ala.		–	1 457	.04
94.	Cleveland Electric Illuminating Cleveland, Ohio		–	1 450	.04
95.	Canoga Electronics Corp. Van Nuys, Calif.	(S)	71	1 412	.04
96.	Associated Builders Corp. Cleveland, Ohio	(S)	–	1 408	.04
97.	Radiation Service Co. Melbourne, Fla.		–	1 396	.04
98.	Schjeldahl, G. T. Co. Northfield, Minn.	(S)	–	1 395	.04
99.	Hewlett-Packard Co. Palo Alto, Calif.		–	1 377	.04
100.	American Optical Co. Pittsburgh, Pa.		–	1 371	.04
	Other			324 521	9.22

[a] Awards during year include awards on several contracts which have different principal places of performance. The place shown is that which has the largest amount of awards.

[b] Data for individual companies include awards on R&D contracts of $10 000 and over and on all other contracts of $25 000 and over.

[c] Combines awards to Space Technology Laboratories, Inc., and Thompson-Ramo-Wooldridge Inc.

(S) Indicates small business.

Source: NASA, *Annual Procurement Report*, FY 1964.

Table 5-24. Top One Hundred Contractors: FY 1965

	Contractor and Place of Contract Performance[a]	Rank in FY 1964	Net Value of Awards[b]	
			Thousands of Dollars	Percentage of Total
	Total Awards to Business		*4 141 434*	*100.00*
1.	North American Aviation, Inc. Downey, Calif.	1	1 099 448	26.55
2.	Boeing Co. New Orleans, La.	4	305 988	7.39
3.	Grumman Aircraft Engineering Corp. Bethpage, N.Y.	5	267 226	6.45
4.	Douglas Aircraft Co., Inc. Santa Monica, Calif.	3	251 668	6.08
5.	General Electric Co. Huntsville, Ala.	7	181 472	4.38
6.	McDonnell Aircraft Corp. St. Louis, Mo.	2	166 670	4.02
7.	International Business Machines Corp. Huntsville, Ala.	10	128 312	3.10
8.	Aerojet-General Corp. Sacramento, Calif.	8	123 186	2.97
9.	General Dynamics Corp. San Diego, Calif.	6	111 148	2.68
10.	Radio Corporation of America Princeton, N.J.	11	106 552	2.57
11.	Chrysler Corp. New Orleans, La.	9	85 986	2.08
12.	General Motors Corp. Milwaukee, Wisc.	13	72 531	1.75
13.	Bendix Corp. Teterboro, N.J.	12	66 100	1.60
14.	TRW Space Technology Laboratories Redondo Beach, Calif.	16[c]	50 533	1.22
15.	United Aircraft Corp. West Palm Beach, Fla.	17	43 330	1.05
16.	Sperry Rand Corp. St. Paul, Minn.	28	39 401	.95
17.	Lockheed Aircraft Corp. Sunnyvale, Calif.	15	35 796	.86
18.	Collins Radio Co. Richardson, Tex.	51	31 532	.76
19.	Brown Engineering Co., Inc. Huntsville, Ala.	14	30 850	.74
20.	Philco Corp. Houston, Tex.	18	30 029	.73
21.	Hayes International Corp. Birmingham, Ala.	22	28 496	.69
22.	Honeywell, Inc. St. Petersburg, Fla.	40	27 068	.65
23.	Hughes Aircraft Co. Culver City, Calif.	25	26 457	.64
24.	Catalytic Construction Co. Merritt Island, Fla.	44	25 296	.61
25.	Trans World Airlines, Inc. Various	–	20 862	.50
26.	Union Carbide Corp. Fontana, Calif.	21	19 954	.48
27.	LTV Aerospace Corp. Dallas, Tex.	20[d]	15 118	.37
28.	Fairchild Hiller Corp. Hagerstown, Md.	31	14 720	.36
29.	Mason-Rust New Orleans, La.	27	13 097	.32
30.	Westinghouse Electric Corp. Baltimore, Md.	45	12 647	.31
31.	Radiation, Inc. Melbourne, Fla.	30	12 056	.29
32.	Control Data Corp. Minneapolis, Minn.	24	11 808	.29
33.	Bellcomm, Inc. Washington, D.C.	37	9 804	.24
34.	Pacific Crane & Rigging Merritt Island, Fla.	–	9 280	.22
35.	Martin Marietta Corp. Baltimore, Md.	38	8 389	.20
36.	Lear Siegler, Inc. Anaheim, Calif.	73	8 260	.20
37.	Air Products & Chemicals, Inc. Long Beach, Calif.	33	8 135	.20

Table 5-24. Top One Hundred Contractors: FY 1965 (Continued)

	Contractor and Place of Contract Performance[a]	Rank in FY 1964	Net Value of Awards[b] Thousands of Dollars	Net Value of Awards[b] Percentage of Total
38.	Republic Aviation Corp. Farmingdale, N.Y.	35	7 537	.18
39.	Thiokol Chemical Corp. Brunswick, Ga.	69	7 441	.18
40.	Northrop Corporation Hawthorne, Calif.	36	7 297	.18
41.	Garrett Corp. Los Angeles, Calif.	57	7 179	.17
42.	Scientific Data Systems Santa Monica, Calif.	53	6 800	.16
43.	American Machine & Foundry Co. York, Pa.	66	6 614	.16
44.	Dynatronics, Inc. (S) Orlando, Fla.	–	6 436	.16
45.	Spaco, Inc. (S) Huntsville, Ala.	46	6 308	.15
46.	Avco Corp. Wilmington, Mass.	52	6 299	.15
47.	Electronic Associates, Inc. West Long Branch, N.J.	63	6 025	.15
48.	Motorola, Inc. Scottsdale, Ariz.	76	5 830	.14
49.	Sanders Associates, Inc. Nashua, N.H.	–	5 830	.14
50.	Federal-Mogul-Bower Bearings, Inc. Los Alamitos, Calif.	32	5 603	.14
51.	Documentation, Inc. (S) Bethesda, Md.	39	5 240	.13
52.	Blount/Chicago Bridge (joint venture) Sandusky, Ohio	–	5 178	.13
53.	Ball Bros. Research Corp. Boulder, Colorado	43	5 036	.12
54.	Keltec Industries (S) Alexandria, Va.	–	4 749	.11
55.	Ampex Corp. Redwood City, Calif.	48	4 747	.11
56.	Norair Engineering Corp. Greenbelt, Md.	–	4 736	.11
57.	Electro-Mechanical Research, Inc. Sarasota, Fla.	47	4 615	.11
58.	Vitro Corporation of America Huntsville, Ala.	72	4 435	.11
59.	Dynamic Corporation of America Garden City, N.Y.	–	4 358	.11
60.	Minnesota Mining & Mfg. Co. Camarillo, Calif.	–	4 257	.10
61.	Graham Engineering Co. (S) Houston, Tex.	–	4 063	.10
62.	Brown/Northrop (joint venture) Houston, Tex.	–	4 060	.10
63.	Beckman Instruments, Inc. Fullerton, Calif.	77	3 997	.10
64.	Computer Control Co. Framingham, Mass.	–	3 908	.09
65.	Wolf Research & Develop. Corp. (S) Houston, Tex.	–	3 882	.09
66.	Clark David Co., Inc. Worcester, Mass.	–	3 839	.09
67.	Taag Designs, Inc. (S) College Park, Md.	–	3 790	.09
68.	Zia Company Las Cruces, N.M.	91	3 779	.09
69.	Allis-Chalmers Manufacturing Co. Milwaukee, Wisc.	–	3 701	.09
70.	Pennsalt Chemical Corp. Various	–	3 559	.09
71.	Consolidated Systems Corp. Monrovia, Calif.	81	3 555	.09
72.	Calumet & Hecla, Inc. Bartlett, Ill.	–	3 418	.08
73.	Aero Spacelines, Inc. (S) Van Nuys, Calif.	–	3 387	.08
74.	MSI Corporation Greenbelt, Md.	–	3 386	.08
75.	Bell Aerospace Corp. Buffalo, N.Y.	49	3 328	.08

Table 5-24. Top One Hundred Contractors: FY 1965 (Continued)

	Contractor and Place of Contract Performance[a]		Rank in FY 1964	Net Value of Awards[b] Thousands of Dollars	Net Value of Awards[b] Percentage of Total
76.	Space-General Corp. El Monte, Calif.		64	3 293	.08
77.	Hathaway E A & Co. Mountain View, Calif.	(S)	–	3 216	.08
78.	Systems Engineering Labs, Inc. Ft. Lauderdale, Fla.	(S)	89	3 019	.07
79.	Electronic Communications, Inc. St. Petersburg, Fla.		–	2 952	.07
80.	Consolidated Electrodynamics Corp. Pasadena, Calif.		58	2 938	.07
81.	Kiewit/Leavell (joint venture) Sandusky, Ohio		–	2 820	.07
82.	Electro Optical Systems, Inc. Pasadena, Calif.		84	2 808	.07
83.	Sylvania Electric Products, Inc. Waltham, Mass.		–	2 652	.06
84.	Washington Technological Asso., Inc. Rockville, Md.	(S)	–	2 615	.06
85.	Wise Contracting Co. Hampton, Va.	(S)	–	2 561	.06
86.	Sun Shipbuilding & Dry Dock Co. Chester, Pa.		–	2 554	.06
87.	Litton Industries, Inc. College Park, Md.		–	2 449	.06
88.	Virginia Electric Power Co. Hampton, Va.		–	2 421	.06
89.	Western Union Telegraph Co. Various		–	2 397	.06
90.	Universal Marion Corp. Marion, Ohio		–	2 341	.06
91.	Swenson Carl N. Co. Mountain View, Calif.		–	2 324	.06
92.	Whittaker Corp. Van Nuys, Calif.		83	2 297	.06
93.	Consultants & Designers, Inc. Arlington, Va.		–	2 207	.05
94.	Raytheon Co. Wayland, Mass.		19	2 200	.05
95.	Canoga Electronics Corp. Van Nuys, Calif.	(S)	95	2 172	.05
96.	Int'l. Telephone & Telegraph Corp. San Fernando, Calif.		71	2 153	.05
97.	Dow Chemical Co. Various		–	2 070	.05
98.	Melpar, Inc. Falls Church, Va.		–	2 069	.05
99.	Dortech Corp. Various		–	2 064	.05
100.	Management Services, Inc. Huntsville, Ala.	(S)	74	2 061	.05
	Other			391 374	9.45

[a] Awards during year include awards on several contracts which have different principal places of performance. The place shown is that which has the largest amount of awards.

[b] Data for individual companies include awards on R&D contracts of $10 000 and over and on all other contracts of $25 000 and over.

[c] Rank of Thompson-Ramo-Wooldridge Inc., of which TRW Space Technology Laboratories was then a division.

[d] Rank of Ling-Temco-Vought, Inc., of which LTV Aerospace Corp. was then a division.

(S) Indicates small business.

Source: NASA, *Annual Procurement Report*, FY 1965.

Table 5-25. Top One Hundred Contractors: FY 1966

	Contractor and Place of Contract Performance[a]	Rank in FY 1965	Net Value of Awards[b]	
			Thousands of Dollars	Percentage of Total
	Total Awards to Business		*4 087 679*	*100.00*
1.	North American Aviation, Inc. Downey, Calif.	1	1 128 928	27.61
2.	Grumman Aircraft Engineering Corp. Bethpage, N.Y.	3	381 152	9.32
3.	Boeing Co. New Orleans, La.	2	313 682	7.67
4.	Douglas Aircraft Co., Inc. Santa Monica, Calif.	4	259 697	6.35
5.	General Electric Co. Huntsville, Ala.	5	235 652	5.76
6.	General Motors Corp. Milwaukee, Wisc.	12	123 278	3.02
7.	Int'l Business Machines Corp. Huntsville, Ala.	7	108 181	2.65
8.	Aerojet-General Corp. Sacramento, Calif.	8	100 494	2.46
9.	General Dynamics Corp. San Diego, Calif.	9	92 076	2.25
10.	Chrysler Corp. New Orleans, La.	11	83 481	2.04
11.	Bendix Corp. Owings Mills, Md.	13	78 030	1.91
12.	McDonnell Aircraft Corp. St. Louis, Mo.	6	52 316	1.28
13.	Radio Corporation of America Huntsville, Ala.	10	51 343	1.26
14.	TRW Inc. Redondo Beach, Calif.	14[c]	49 886	1.22
15.	Lockheed Aircraft Corp. Sunnyvale, Calif.	17	44 541	1.09
16.	United Aircraft Corp. West Palm Beach, Fla.	15	40 703	1.00
17.	Sperry Rand Corp. Huntsville, Ala.	16	29 540	.72
18.	LTV Aerospace Corp. Dallas, Tex.	27	28 763	.70
19.	Hayes International Corp. Birmingham, Ala.	21	28 111	.69
20.	Philco Corp. Houston, Tex.	20	25 445	.62
21.	Brown Engineering Co. Huntsville, Ala.	19	24 303	.59
22.	Hughes Aircraft Co. Culver City, Calif.	23	22 365	.55
23.	Honeywell, Inc. St. Petersburg, Fla.	22	22 238	.54
24.	Union Carbide Corp. Sacramento, Calif.	26	19 735	.48
25.	Collins Radio Co. Richardson, Tex.	18	16 968	.42
26.	Fairchild Hiller Corp. Farmingdale, N.Y.	[d]	15 252	.37
27.	Mason-Rust New Orleans, La.	29	12 156	.30
28.	Thiokol Chemical Corp. Denville, N.J.	39	11 514	.28
29.	Vitro Corporation of America Huntsville, Ala.	58	11 2[illegible]	.28
30.	Air Products & Chemicals, Inc. Long Beach, Calif.	37	[illegible]	.25
31.	Trans World Airlines, Inc. Kennedy Space Center, Fla.	25	1[illegible] 27	.25
32.	Control Data Corp. Minneapolis, Minn.	32	10 137	.25
33.	Northrop Corp. Huntsville, Ala.	40	9 704	.24
34.	Bellcomm, Inc. Washington, D.C.	33	9 685	.24
35.	Westinghouse Electric Corp. Baltimore, Md.	30	9 518	.23
36.	Spaco, Inc. (S) Huntsville, Ala.	45	8 391	.21
37.	Brown/Northrop (joint venture) Houston, Tex.	62	7 394	.18

Table 5-25. Top One Hundred Contractors: FY 1966 (Continued)

	Contractor and Place of Contract Performance[a]	Rank in FY 1965	Net Value of Awards[b]	
			Thousands of Dollars	Percentage of Total
38.	Bechtel Corp. Cape Kennedy, Fla.	–	7 182	.18
39.	Garrett Corp. Los Angeles, Calif.	41	7 032	.17
40.	Scientific Data Systems Santa Monica, Calif.	42	6 340	.16
41.	Graham Engineering Co. (S) Houston, Tex.	61	6 199	.15
42.	Space-General Corp. El Monte, Calif.	76	6 176	.15
43.	Management Services, Inc. (S) Huntsville, Ala.	100	6 022	.15
44.	Ball Brothers Research Corp. Boulder, Colo.	53	5 964	.15
45.	Documentation, Inc. College Park, Md.	51	5 781	.14
46.	Martin Marietta Corp. Baltimore, Md.	35	5 723	.14
47.	Catalytic Construction Co. Kennedy Space Center, Fla.	24	5 471	.13
48.	Pacific Crane & Rigging Co. Kennedy Space Center, Fla.	34	5 393	.13
49.	Federal Electric Corp. Kennedy Space Center, Fla.	–	5 129	.13
50.	International Latex Corp. Dover, Del.	–	4 943	.12
51.	Avco Corp. Wilmington, Mass.	46	4 907	.12
52.	Zia Co. Las Cruces, N. Mex.	68	4 891	.12
53.	Sanders Associates, Inc. Nashua, N.H.	49	4 799	.12
54.	Radiation, Inc. Melbourne, Fla.	31	4 686	.11
55.	Gulton Industries, Inc. Albuquerque, N. Mex.	–	4 429	.11
56.	Ampex Corp. Redwood City, Calif.	55	4 384	.11
57.	Electro Optical Systems, Inc. Pasadena, Calif.	82	4 366	.11
58.	Dow Chemical Co. Titusville, Fla.	97	4 223	.10
59.	Electronic Associates, Inc. West Long Branch, N.J.	47	4 212	.10
60.	Western Electric Co. New York, N.Y.	–	4 172	.10
61.	American Telephone & Telegraph Co. Greenbelt, Md.	–	4 106	.10
62.	General Precision, Inc. Houston, Tex.	–	4 063	.10
63.	Motorola, Inc. Scottsdale, Ariz.	48	3 952	.10
64.	Melpar, Inc. Falls Church, Va.	98	3 728	.09
65.	American Machine & Foundry Co. York, Pa.	43	3 692	.09
66.	American Science & Engrg., Inc. (S) Cambridge, Mass.	–	3 623	.09
67.	Int'l. Telephone & Telegraph Corp. Fort Wayne, Ind.	96	3 428	.08
68.	Raytheon Co. Wayland, Mass.	94	3 217	.08
69.	Sylvania Electric Products, Inc. Waltham, Mass.	83	3 195	.08
70.	Allis-Chalmers Manufacturing Co. Milwaukee, Wisc.	69	3 124	.08
71.	Telecomputing Services, Inc. Greenbelt, Md.	–	3 022	.07
72.	Computer Sciences Corp. El Segundo, Calif.	–	2 941	.07
73.	Electronic Communications, Inc. St. Petersburg, Fla.	79	2 872	.07
74.	Keltec Industries, Inc. Alexandria, Va.	54	2 869	.07
75.	Aero Spacelines, Inc. (S) Van Nuys, Calif.	73	2 856	.07

Table 5-25. Top One Hundred Contractors: FY 1966 (Continued)

	Contractor and Place of Contract Performance[a]	Rank in FY 1965	Net Value of Awards[b]	
			Thousands of Dollars	Percentage of Total
76.	David Clark Co., Inc. Worcester, Mass.	66	2 771	.07
77.	Systems Engrg. Laboratories, Inc. (S) Ft. Lauderdale, Fla.	78	2 701	.07
78.	Consolidated Electrodynamics Corp. Pasadena, Calif.	80	2 666	.07
79.	Electro-Mechanical Research, Inc. College Park, Md.	57	2 624	.06
80.	Norair Engineering Corp. Greenbelt, Md.	56	2 476	.06
81.	Texas Instruments, Inc. Dallas, Tex.	–	2 456	.06
82.	Cryovac, Inc. Houston, Tex.	–	2 321	.06
83.	Air Reduction Co. Buena Park, Calif.	–	2 313	.06
84.	Clevite Corp. Cleveland, Ohio	–	2 268	.06
85.	Carl N. Swenson Co. Mountain View, Calif.	91	2 194	.05
86.	Wolf Research & Develop. Corp. (S) Arlington, Va.	65	2 188	.05
87.	Virginia Electric Power Co. Hampton, Va.	88	2 181	.05
88.	Washington Tech. Assocs., Inc. (S) Rockville, Md.	84	2 146	.05
89.	GCA Corp. Bedford, Mass.	–	2 142	.05
90.	Astrodata, Inc. (S) Anaheim, Calif.	–	2 094	.05
91.	Minnesota Mining & Mfg. Co. Camarillo, Calif.	60	2 029	.05
92.	Arinc Research Corp. Huntsville, Ala.	–	2 006	.05
93.	Computer Application, Inc. New York, N.Y.	–	1 984	.05
94.	Chesapeake & Potomac Telephone Co. Greenbelt, Md.	–	1 979	.05
95.	Bell Aerospace Corp. Buffalo, N.Y.	75	1 971	.05
96.	Litton Industries, Inc. Beverly Hills, Calif.	87	1 915	.05
97.	Marion Power Shovel Co. Marion, Ohio	90	1 844	.05
98.	Consultants & Designers, Inc. Arlington, Va.	93	1 812	.04
99.	Marquardt Corp. Van Nuys, Calif.	–	1 767	.04
100.	Kollsman Instrument Corp. Syosset, N.Y.	–	1 711	.04
	Other		373 601	9.14

[a] Awards during year include awards on several contracts which have different principal places of performance. The place shown is that which has the largest amount of awards.

[b] Data for individual companies include awards on R&D contracts of $10 000 and over and on all other contracts of $25 000 and over.

[c] Rank of TRW Space Laboratories, a division of TRW Inc.

[d] Data for current year include awards to Republic Aviation Corp., now a division of Fairchild Hiller Corp. For Fiscal Year 1965, these companies ranked 25th on a combined basis.

(S) Indicates small business.

Source: NASA, *Annual Procurement Report*, FY 1966.

Table 5-26. Top One Hundred Contractors: FY 1967

	Contractor and Place of Contract Performance[a]	Rank in FY 1966	Net Value of Awards[b]	
			Thousands of Dollars	Percentage of Total
	Total Awards to Business		*3 864 133*	*100.00*
1.	North American Aviation, Inc. Downey, Calif.	1	983 814	25.46
2.	Grumman Aircraft Engrg. Corp. Bethpage, N.Y.	2	481 137	12.45
3.	Boeing Co. New Orleans, La.	3	273 514	7.08
4.	McDonnell Douglas Corp. Santa Monica, Calif.	4[c]	243 913	6.31
5.	Int'l. Business Machines Corp. Huntsville, Ala.	7	186 355	4.82
6.	General Electric Co. Huntsville, Ala.	5	179 261	4.64
7.	Bendix Corp. Owings Mills, Md.	11	120 028	3.11
8.	Aerojet-General Corp. Sacramento, Calif.	8	95 691	2.48
9.	Chrysler Corp. New Orleans, La.	10	76 602	1.98
10.	General Motors Corp. Milwaukee, Wisc.	6	65 222	1.69
11.	General Dynamics Corp. San Diego, Calif.	9	60 990	1.58
12.	Radio Corporation of America Princeton, N.J.	13	57 512	1.49
13.	TRW Inc. Redondo Beach, Calif.	14	52 551	1.36
14.	LTV Aerospace Corp. Dallas, Tex.	18	46 326	1.20
15.	Lockheed Aircraft Corp. Houston, Texas	15	42 036	1.09
16.	United Aircraft Corp. West Palm Beach, Fla.	16	39 989	1.03
17.	Sperry Rand Corp. Huntsville, Ala.	17	38 666	1.00
18.	Philco-Ford Corp. Houston, Tex.	20	32 059	.83
19.	Trans World Airlines, Inc. Kennedy Space Center, Fla.	31	25 091	.65
20.	General Precision, Inc. Houston, Tex.	62	24 987	.65
21.	Honeywell, Inc. St. Petersburg, Fla.	23	22 647	.59
22.	Hughes Aircraft Co. Culver City, Calif.	22	19 850	.51
23.	Brown Engineering Co., Inc. Huntsville, Ala.	21	16 713	.43
24.	Martin Marietta Corp. Denver, Colo.	46	12 828	.33
25.	Union Carbide Corp. Sacramento, Calif.	24	12 648	.33
26.	Federal Electric Corp. Kennedy Space Center, Fla.	49	12 305	.32
27.	Computer Sciences Corp. Huntsville, Ala.	72	11 796	.31
28.	Air Products & Chemicals, Inc. Long Beach, Calif.	30	11 788	.31
29.	Thiokol Chemical Corp. Denville, N.J.	28	11 455	.30
30.	Mason-Rust New Orleans, La.	27	11 213	.29
31.	Catalytic Construction Co. Kennedy Space Center, Fla.	47	11 051	.29
32.	Westinghouse Electric Corp. Baltimore, Md.	35	10 388	.27
33.	Brown/Northrop (joint venture) Houston, Tex.	37	10 000	.26
34.	Fairchild Hiller Corp. Greenbelt, Md.	26	9 794	.25
35.	Bellcomm, Inc. Washington, D.C.	34	9 318	.24
36.	Garrett Corp. Los Angeles, Calif.	39	9 293	.24
37.	Bechtel Corp. Cape Kennedy, Fla.	38	9 198	.24

Table 5-26. Top One Hundred Contractors: FY 1967 (Continued)

	Contractor and Place of Contract Performance[a]		Rank in FY 1966	Net Value of Awards[b]	
				Thousands of Dollars	Percentage of Total
38.	Vitro Corporation of America Huntsville, Ala.		29	8 988	.23
39.	Bell Aerospace Corp. Buffalo, N.Y.		95	8 877	.23
40.	Northrop Corp. Huntsville, Ala.		33	8 815	.23
41.	Hayes International Corp. Birmingham, Ala.		19	7 289	.19
42.	Control Data Corp. Minneapolis, Minn.		32	7 111	.18
43.	Graham Engineering Co., Inc. Houston, Tex.	(S)	41	7 109	.18
44.	Scientific Data Systems Greenbelt, Md.		40	7 080	.18
45.	Spaco, Inc. Huntsville, Ala.	(S)	36	6 785	.18
46.	Ball Brothers Research Corp. Boulder, Colo.		44	6 648	.17
47.	Dow Chemical Co. Titusville, Fla.		58	6 471	.17
48.	ILC Industries, Inc. Dover, Del.		50	6 336	.16
49.	Documentation, Inc. College Park, Md.		45	5 880	.15
50.	Warrior/Natkin/Nat'l. Electric Houston, Tex.		–	5 776	.15
51.	Sanders Associates, Inc. Nashua, N.H.		53	5 626	.15
52.	Zia Company Las Cruces, N.M.		52	5 096	.13
53.	Space-General Corp. El Monte, Calif.		42	5 007	.13
54.	Management Services, Inc. Huntsville, Ala.		43	4 745	.12
55.	Basic Construction Co. Hampton, Va.		–	4 737	.12
56.	Allis-Chalmers Manufacturing Co. Milwaukee, Wisc.		70	4 731	.12
57.	Southern Bell Telephone Co. Huntsville, Ala.		–	4 432	.11
58.	American Tel. & Tel. Co. Greenbelt, Md.		61	4 397	.11
59.	American Science & Engrg., Inc. Cambridge, Mass.	(S)	66	4 175	.11
60.	Aero Spacelines, Inc. Van Nuys, Calif.	(S)	75	3 631	.09
61.	Gillmore-Olson Co. Cleveland, Ohio	(S)	–	3 602	.09
62.	Perkin-Elmer Corp. Norwalk, Conn.		–	3 546	.09
63.	Western Union Telegraph Co. Washington, D.C.		–	3 472	.09
64.	Computer Application, Inc. New York, N.Y.		93	3 461	.09
65.	Wolf Research & Develop. Corp. Arlington, Va.	(S)	86	3 360	.09
66.	Computing & Software, Inc. Greenbelt, Md.		71	3 337	.09
67.	Electronic Associates, Inc. West Long Branch, N.J.		59	3 312	.09
68.	Pacific Crane & Rigging Co. Kennedy Space Center, Fla.		48	3 234	.08
69.	Lawrence, J. H. Co. Greenbelt, Md.	(S)	–	3 226	.08
70.	Ampex Corp. Redwood City, Calif.		56	3 176	.08
71.	Avco Corp. Wilmington, Mass.		51	3 049	.08
72.	Electro Optical Systems, Inc. Pasadena, Calif.		57	2 896	.07
73.	Air Reduction Co. New Orleans, La.		83	2 754	.07
74.	Communications Satellite Corp. Andover, Me.		–	2 745	.07
75.	Int'l. Tel. & Tel. Corp. Fort Wayne, Ind.		67	2 651	.07

Table 5-26. Top One Hundred Contractors: FY 1967 (Continued)

Contractor and Place of Contract Performance[a]		Rank in FY 1966	Net Value of Awards[b]	
			Thousands of Dollars	Percentage of Total
76. Melpar, Inc. Greenbelt, Md.	(S)	64	2 640	.07
77. Radiation, Inc. Melbourne, Fla.		54	2 506	.06
78. Texas Instruments, Inc. Dallas, Texas		81	2 440	.06
79. Consolidated Electrodynamics Corp. Rochester, N.Y.		78	2 405	.06
80. Systems Engrg. Lab., Inc. Ft. Lauderdale, Fla.	(S)	77	2 360	.06
81. GCA Corp. Bedford, Mass.		89	2 342	.06
82. New Orleans Public Service, Inc. New Orleans, La.		–	2 312	.06
83. Western Electric Co. Cape Kennedy, Fla.		60	2 282	.06
84. Motorola, Inc. Scottsdale, Ariz.		63	2 219	.06
85. Dynalectron Corp. Houston, Tex.		–	2 162	.06
86. Keltec Industries, Inc. College Park, Md.		74	2 098	.05
87. Virginia Electric Power Co. Hampton, Va.		87	2 053	.05
88. Kaiser Industries Corp. Oakland, Calif.		–	2 032	.05
89. Goodyear Aerospace Corp. Akron, Ohio		–	1 997	.05
90. Greenhut Construction, Inc. Pensacola, Fla.	(S)	–	1 960	.05
91. Electro-Mechanical Research, Inc. College Park, Md.		79	1 945	.05
92. Kollsman Instrument Corp. Syosset, N.Y.		100	1 939	.05
93. Minnesota Mining & Mfg. Co. Hutchinson, Minn.		91	1 935	.05
94. Sylvania Electric Products, Inc. Waltham, Mass.		69	1 880	.05
95. Pearce DeMoss King, Inc. Huntsville, Ala.	(S)	–	1 858	.05
96. Hazeltine Corp. New York, N.Y.		–	1 807	.05
97. Cleveland Electric Illuminating Co. Cleveland, Ohio		–	1 790	.05
98. ITT World Communications, Inc. New York, N.Y.		–	1 764	.05
99. Marquardt Corp. Van Nuys, Calif.		99	1 758	.05
100. Western Union International, Inc. New York, N.Y.		–	1 742	.05
Other			286 315	7.41

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[a] Awards during the year include awards on several contracts which have different principal places of performance. The place shown is that which has the largest amount of awards.

[b] Data for individual companies include awards on R&D contracts of $10 000 and over and on all other contracts of $25 000 and over.

[c] Combined awards to Douglas Aircraft Co., Inc., and McDonnell Aircraft Corp.

(S) Indicates small business.

Source: NASA, *Annual Procurement Report*, FY 1967.

Table 5-27. Top One Hundred Contractors: FY 1968

	Contractor and Place of Contract Performance[a]	Rank in FY 1967	Net Value of Awards[b]	
			Thousands of Dollars	Percentage of Total
	Total Awards to Business		*3 446 703*	*100.00*
1.	North American Rockwell Corp. Downey, Calif.	1	838 734	24.33
2.	Grumman Aircraft Engrg. Corp. Bethpage, N.Y.	2	394 138	11.43
3.	Boeing Co. New Orleans, La.	3	296 683	8.61
4.	McDonnell Douglas Corp. Santa Monica, Calif.	4	209 001	6.06
5.	General Electric Co. Daytona Beach, Fla.	6	190 723	5.53
6.	Int'l. Business Machines Corp. Huntsville, Ala.	5	147 653	4.28
7.	Bendix Corp. Owings Mills, Md.	7	123 832	3.59
8.	Aerojet-General Corp. Sacramento, Calif.	8	67 073	1.95
9.	Radio Corporation of America Princeton, N.J.	12	63 212	1.83
10.	Chrysler Corp. New Orleans, La.	9	62 627	1.82
11.	General Dynamics Corp. San Diego, Calif.	11	54 444	1.58
12.	TRW Inc. Houston, Tex.	13	52 395	1.52
13.	General Motors Corp. Milwaukee, Wisc.	10	46 838	1.36
14.	LTV Aerospace Corp. Dallas, Tex.	14	42 705	1.24
15.	Lockheed Aircraft Corp. Houston, Tex.	15	40 460	1.17
16.	Philco-Ford Corp. Houston, Tex.	18	31 969	.93
17.	Sperry Rand Corp. Huntsville, Ala.	17	31 823	.92
18.	Martin Marietta Corp. Denver, Colo.	24	26 791	.78
19.	Trans World Airlines, Inc. Kennedy Space Center, Fla.	19	25 275	.73
20.	Federal Electric Corp. Kennedy Space Center, Fla.	26	21 998	.64
21.	Catalytic-Dow (joint venture) Kennedy Space Center, Fla.	–	18 836	.55
22.	United Aircraft Corp. Windsor Locks, Conn.	16	18 084	.52
23.	Brown Engineering Co., Inc. Huntsville, Ala.	23	16 336	.47
24.	Honeywell, Inc. St. Petersburg, Fla.	21	15 749	.46
25.	Control Data Corp. Minneapolis, Minn.	42	15 518	.45
26.	Northrop Corp. Huntsville, Ala.	40	15 378	.45
27.	Union Carbide Corp. Sacramento, Calif.	25	15 345	.45
28.	Brown/Northrop (joint venture) Houston, Tex.	33	14 522	.42
29.	General Precision Systems, Inc. Houston, Tex.	20	12 424	.36
30.	Mason-Rust New Orleans, La.	30	12 094	.35
31.	Computer Sciences Corp. Huntsville, Ala.	27	11 796	.34
32.	Garrett Corporation Los Angeles, Calif.	36	10 661	.31
33.	Bellcomm, Inc. Washington, D.C.	35	10 000	.29
34.	Hughes Aircraft Co. Culver City, Calif.	22	9 675	.28
35.	Comm. Satellite Corp. Andover, Me.	74	8 460	.25
36.	ILC Industries, Inc. Dover, Del.	48	8 085	.23
37.	Vitro Corporation of America Huntsville, Ala.	38	7 513	.22

Table 5-27. Top One Hundred Contractors: FY 1968 (Continued)

	Contractor and Place of Contract Performance[a]		Rank in FY 1967	Net Value of Awards[b]	
				Thousands of Dollars	Percentage of Total
38.	Westinghouse Electric Corp. Friendship Airport, Md.		32	7 370	.21
39.	Fairchild Hiller Corp. Greenbelt, Md.		34	6 747	.20
40.	American Science & Engrg., Inc. Cambridge, Mass.	(S)	59	6 471	.19
41.	Leasco Systems & Research Corp. College Park, Md.		49	6 291	.18
42.	Spaco, Inc. Huntsville, Ala.	(S)	45	6 039	.18
43.	Radiation, Inc. Melbourne, Fla.		77	5 507	.16
44.	Zia Co. Las Cruces, N.M.		52	5 364	.16
45.	Avco Corp. Lowell, Mass.		71	5 309	.15
46.	Management Services, Inc. Huntsville, Ala.		54	5 302	.15
47.	Air Products & Chemicals, Inc. Allentown, Pa.		28	5 244	.15
48.	Sanders Associates, Inc. Nashua, N.H.		51	5 231	.15
49.	Computing & Software, Inc. Greenbelt, Md.		66	4 721	.14
50.	Perkin-Elmer Corp. Norwalk, Conn.		62	4 717	.14
51.	Ball Brothers Research Corp. Boulder, Colo.		46	4 496	.13
52.	Teledyne, Inc. Northridge, Calif.		–	4 177	.12
53.	Weston Instruments, Inc. College Park, Md.		–	4 037	.12
54.	Minnesota Mining & Mfg. Co. Hutchinson, Minn.		93	4 009	.12
55.	Bell Aerospace Corp. Buffalo, N.Y.		39	3 720	.11
56.	Hayes International Corp. Birmingham, Ala.		41	3 702	.11
57.	Wackenhut Services, Inc. Houston, Tex.		–	3 669	.11
58.	American Tel. & Tel. Co. Greenbelt, Md.		58	3 650	.11
59.	Scientific Data Systems Santa Monica, Calif.		44	3 336	.10
60.	Thiokol Chemical Corp. Brunswick, Ga.		29	3 310	.10
61.	Aero Spacelines, Inc. Van Nuys, Calif.	(S)	60	3 177	.09
62.	Graham Engineering Co., Inc. Houston, Tex.	(S)	43	3 112	.09
63.	Computer Application, Inc. New York, N.Y.		64	3 108	.09
64.	Chesapeake & Potomac Tel. Co. Greenbelt, Md.		–	3 089	.09
65.	Southern Bell Tel. Co. Kennedy Space Center, Fla.		57	2 970	.09
66.	Dynalectron Corp. Houston, Tex.		85	2 961	.09
67.	Wolf Research & Develop. Corp. Arlington, Va.		65	2 950	.09
68.	Texas Instruments, Inc. Attleboro, Mass.		78	2 780	.08
69.	Electronic Associates, Inc. West Long Branch, N.J.		67	2 672	.08
70.	Comcor, Inc. Anaheim, Calif.		–	2 502	.07
71.	Lawrence, J. H. Co. Greenbelt, Md.	(S)	69	2 460	.07
72.	Catalytic Construction Co. Kennedy Space Center, Fla.		31	2 423	.07
73.	Int'l. Tel. & Tel. Corp. Fort Wayne, Ind.		75	2 285	.07
74.	SJ Industries, Inc. Alexandria, Va.	(S)	–	2 235	.06
75.	Western Gear Corp. Hampton, Va.		–	2 227	.06
76.	Cleveland Elec. Illuminating Co. Cleveland, Ohio		97	2 210	.06

Table 5-27. Top One Hundred Contractors: FY 1968 (Continued)

	Contractor and Place of Contract Performance[a]		Rank in FY 1967	Net Value of Awards[b]	
				Thousands of Dollars	Percentage of Total
77.	Textron, Inc. Sylmar, Calif.		–	2 110	.06
78.	Virginia Electric Power Co. Hampton, Va.		87	2 109	.06
79.	Collins Radio Co. Richardson, Tex.		–	2 092	.06
80.	Chicago Bridge & Iron Co. Hampton, Va.		–	2 081	.06
81.	Ampex Corp. Redwood City, Calif.		70	2 023	.06
82.	Potomac Electric Power Co. Greenbelt, Md.		–	1 973	.06
83.	Electro Optical Systems, Inc. Pasadena, Calif.		72	1 847	.05
84.	Western Electric Co., Inc. Cape Kennedy, Fla.		83	1 803	.05
85.	ITT World Communications, Inc. New York, N.Y.		98	1 782	.05
86.	Beckman Instruments, Inc. Fullerton, Calif.		–	1 755	.05
87.	Astrodata, Inc. Anaheim, Calif.		–	1 702	.05
88.	Western Union Int'l., Inc. New York, N.Y.		100	1 635	.05
89.	Klate Holt Co. Houston, Tex.	(S)	–	1 621	.05
90.	Goodyear Aerospace Corp. Akron, Ohio		89	1 610	.05
91.	Western Union Telegraph Co. Huntsville, Ala.		63	1 537	.04
92.	Memorex Corp. Santa Clara, Calif.		–	1 528	.04
93.	Wyle Laboratories Hampton, Va.		–	1 515	.04
94.	Motorola, Inc. Scottsdale, Ariz.		84	1 513	.04
95.	Hazeltine Corp. New York, N.Y.		96	1 454	.04
96.	Systems Engrg. Labs., Inc. Ft. Lauderdale, Fla.	(S)	80	1 440	.04
97.	Xerox Corp. Kennedy Space Center, Fla.		–	1 347	.04
98.	Southwestern Bell Tel. Co. Houston, Tex.		–	1 346	.04
99.	Hewlett-Packard Co. Palo Alto, Calif.		–	1 315	.04
100.	A–V Corp. Houston, Tex.	(S)	–	1 306	.04
	Other			261 829	7.60

[a] Awards during year include awards on several contracts which have different principal places of performance. The place shown is that which has the largest amount of awards.

[b] Data for individual companies include awards on R&D contracts of $10 000 and over and on all other contracts of $25 000 and over.

(S) Indicates small business concerns.

Source: NASA, *Annual Procurement Report*, FY 1968.

CHAPTER SIX

NASA INSTALLATIONS

CHAPTER SIX

NASA INSTALLATIONS

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NASA INSTALLATIONS

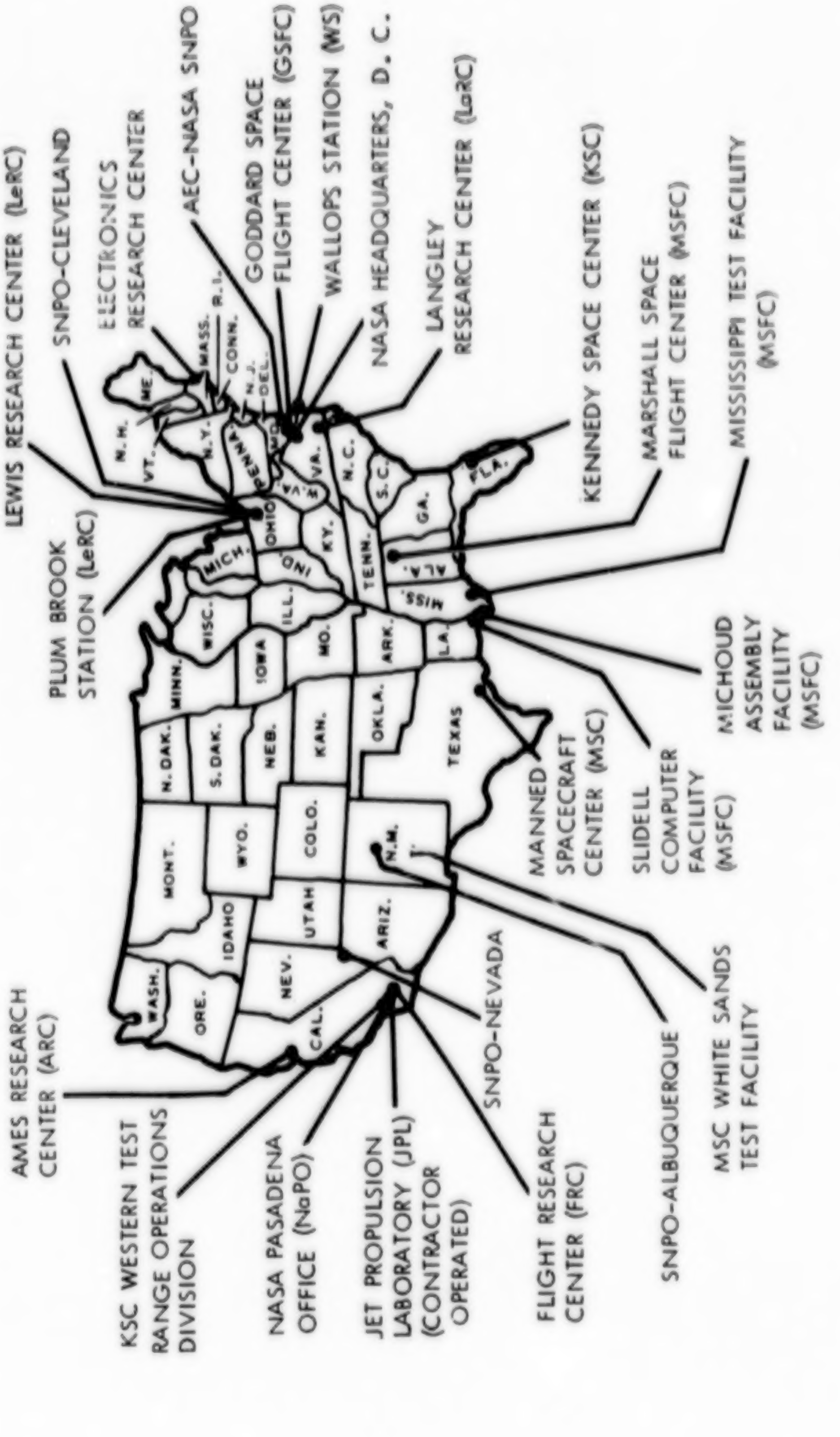
NATIONAL AERONAUTICS AND SPACE ACT OF 1958, AS AMENDED

Section 203(b)

(b) In the performance of its functions the Administration is authorized—

* * * * *

(3) to acquire (by purchase, lease, condemnation, or otherwise), construct, improve, repair, operate, and maintain laboratories, research and testing sites and facilities, aeronautical and space vehicles, quarters and related accommodations for employees and dependents of employees of the Administration, and such other real and personal property (including patents), or any interest therein, as the Administration deems necessary within and outside the continental United States; to acquire by lease or otherwise, through the Administrator of General Services, buildings or parts of buildings in the District of Columbia for the use of the Administration for a period not to exceed ten years without regard to the Act of March 3, 1877 (40 U.S.C. 34); to lease to others such real and personal property; to sell and otherwise dispose of real and personal property (including patents and rights thereunder) in accordance with the provisions of the Federal Property and Administrative Services Act of 1949, as amended (40 U.S.C. 471 et seq.)....


AMES RESEARCH CENTER (ARC)
KSC WESTERN TEST RANGE OPERATIONS DIVISION
NASA PASADENA OFFICE (NaPO)
JET PROPULSION LABORATORY (JPL) (CONTRACTOR OPERATED)
FLIGHT RESEARCH CENTER (FRC)
SNPO-NEVADA
SNPO-ALBUQUERQUE
MSC WHITE SANDS TEST FACILITY
MANNED SPACECRAFT CENTER (MSC)
SLIDELL COMPUTER FACILITY (MSFC)
MICHOUD ASSEMBLY FACILITY (MSFC)
PLUM BROOK STATION (LeRC)
LEWIS RESEARCH CENTER (LeRC)
SNPO-CLEVELAND
ELECTRONICS RESEARCH CENTER
AEC-NASA SNPO
GODDARD SPACE FLIGHT CENTER (GSFC)
WALLOPS STATION (WS)
NASA HEADQUARTERS, D. C.
LANGLEY RESEARCH CENTER (LaRC)
KENNEDY SPACE CENTER (KSC)
MARSHALL SPACE FLIGHT CENTER (MSFC)
MISSISSIPPI TEST FACILITY (MSFC)
WASH.
ORE.
CAL.
IDAHO
NEV.
MONT.
WYO.
UTAH
ARIZ.
COLO.
N.M.
N. DAK.
S. DAK.
NEB.
KAN.
OKLA.
TEXAS
MINN.
IOWA
MO.
ARK.
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MICH.
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TENN.
ALA.
OHIO
W. VA.
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N.C.
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PENNA.
N.Y.
MD.
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N.J.
CONN.
R.I.
MASS.
VT.
N.H.
ME.

CHAPTER SIX

NASA INSTALLATIONS

Introduction

On October 1, 1958, NASA consisted of a Headquarters staff in Washington and nearly 7700 persons working in the research laboratories that had been part of the National Advisory Committee for Aeronautics. Since the establishment of the first laboratory in 1917, these NACA laboratories with their personnel and facilities had formed the Nation's chief governmental research capability in aeronautics. With the signing of the National Aeronautics and Space Act on July 29, 1958, President Eisenhower implemented the decision made in March 1958 that the civilian space program would be built on the NACA core.

The installation profiles in this chapter describe this effort to structure a new agency. They also show the impact of NASA's program acceleration after 1961 and present a detailed picture of each installation complementary to the overall view of previous chapters.

Of the 7867 persons who became NASA permanent employees on October 1, 1958, more than one third were aeronautical research scientists or engineers. Nearly all of them worked in the field at the three laboratories which became "Centers" with the establishment of NASA–Langley Research Center, Ames Research Center, and Lewis Research Center–and at the High Speed Flight Station (renamed Flight Research Center in 1959). These experienced persons brought to NASA a basic strength in aerodynamics, propulsion, structures, and materials research.

Expansion of the capabilities of the basic group of NASA installations began in December 1958 (see Figure 6-1) when contract functions and Government-owned facilities of the California Institute of Technology's Jet Propulsion Laboratory were transferred from the U.S. Army to NASA. Scientists and engineers at Jet Propulsion Laboratory brought NASA additional competence in spacecraft technology, propulsion, lunar and planetary sciences, and deep-space tracking and data acquisition.

The first new NASA installation was authorized by Congress in August 1958 and was under construction in Greenbelt, Maryland, by the end of FY 1959. The new Center, designated Goddard Space Flight Center, was built to house NASA space flight programs, with an initial complement of earth satellite specialists transferred from the Naval Research Laboratory.

Since the summer of 1946, Langley's Pilotless Aircraft Research Division had operated the experimental station on Wallops Island established under the Langley Research Division in 1945. In 1959 Wallops Station, with its sounding rocket launch facilities, became an autonomous NASA installation.

In 1960 Marshall Space Flight Center was established in Huntsville, Alabama, with the transfer to NASA of the U.S. Army Ballistic Missile Agency's Development Operations Division. This transfer–effective July 1, 1960–added to NASA engineering strength in launch operations and launch vehicle design, development, assembly, and testing.

The decision to "take longer strides" in space by accelerating the Apollo, Rover, and applications satellite programs became public when President Kennedy delivered his second State of the Union message to a joint session of Congress on May 25, 1961. He urged commitment of national resources to the goal of landing men on the moon and returning them safely to earth before the decade was out and asked for quicker development of the nuclear rocket and worldwide weather and communications satellite systems.

Congress endorsed his proposals and, one week after the passage of the FY 1962 Appropriations Act, NASA announced on August 24, 1961, that Cape Canaveral had been chosen as the site for manned lunar mission launches. Acquisition of acreage in the Merritt Island area began before the end of the year, with funds reprogrammed from the NASA research and development account. At that time, all NASA launches were conducted either at Wallops Station or from U.S. Air Force facilities at Cape Canaveral, where Marshall Space Flight Center maintained its Launch Operations Directorate.

To meet precise schedules planned for lunar missions, not only launch facilities but all installations for manned space flight had to be located where year-round operations were possible. Originally NASA's manned space flight program had been expected to move to Goddard Space Flight Center, but with the lunar landing decision the expanding program needed separate facilities. On September 19, 1961, NASA announced that a new Manned Spacecraft Center would be built near Houston, Texas.

Two more sites in a temperate climate were required for assembling and testing of launch vehicles. On September 7, 1961, NASA announced its decision to convert an Army manufacturing plant in New Orleans into a launch vehicle assembly facility. The new fabrication site, later designated Michoud Assembly Facility, was to accommodate several contractors under one roof. Organizationally, it was part of Marshall Space Flight Center, which had been assigned responsibility for development of Saturn launch vehicles. A second component of Marshall, near Michoud along the inland water route from Huntsville to the Gulf of Mexico, was announced on October 25, 1961. This site in southwestern Mississippi, later designated Mississippi Test Facility, was to serve as a central test area for launch vehicles and engines.

To carry out the accelerated nuclear rocket program, in July 1961 NASA signed a new, more detailed agreement with the Atomic Energy Commission for the joint Space Nuclear Propulsion Office. In February 1962, NASA and the AEC announced establishment of the Nuclear Rocket Development Station in Nevada.

In March 1962, Marshall's Launch Operations Directorate reorganized, and NASA established two new field installations–Pacific Launch Operations

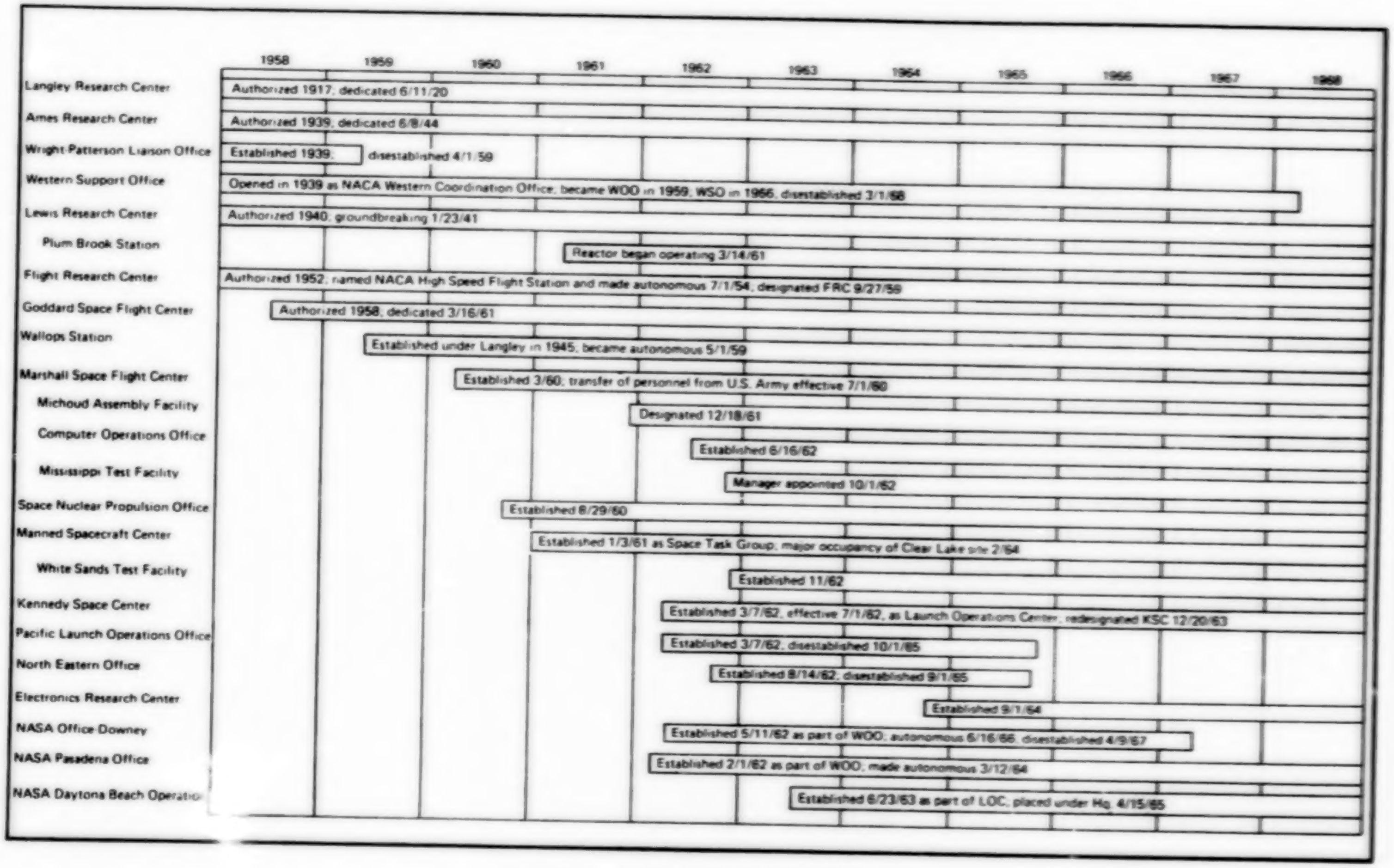


Figure 6-1. NASA installations, 1958-1968.

Table 6–a. Distribution of FY 1968 Research and Development Budget Plan by Installation and Program Office
(in thousands)

Installation	Manned Space Flight	Space Science and Applications	Advanced Research and Technology	Tracking and Data Acquisition	University Affairs	Technology Utilization	Total Budget Plan
Headquarters	$ 52 700	$ 52 235	$ 25 904	$ 10 500	$10 000	$4000	$ 155 339
(% of total budget plan)	(33.9)	(33.6)	(16.7)	(6.8)	(6.4)	(2.6)	(3.9)
Ames Research Center	0	41 544	23 502	0	0	0	65 046
(% of total budget plan)		(63.9)	(36.1)				(1.6)
Electronics Research Center	2 000	3 615	20 655	0	0	0	26 270
(% of total budget plan)	(7.6)	(13.8)	(78.6)				(0.7)
Flight Research Center	0	0	21 668	2 100	0	0	23 768
(% of total budget plan)			(91.2)	(8.8)			(0.6)
Goddard Space Flight Center	3 100	207 607	9 006	197 350	0	0	417 063
(% of total budget plan)	(0.7)	(49.8)	(2.2)	(47.3)			(10.5)
Kennedy Space Center	356 600	5 290	175	0	0	0	362 065
(% of total budget plan)	(98.5)	(1.5)	*				(9.1)
Langley Research Center	1 000	25 717	56 774	1 900	0	0	85 391
(% of total budget plan)	(1.2)	(30.1)	(66.5)	(2.2)			(2.2)
Lewis Research Center	0	79 800	59 263	0	0	0	139 063
(% of total budget plan)		(57.4)	(42.6)				(3.5)
Manned Spacecraft Center	1 271 900	7 109	4 420	0	0	0	1 283 429
(% of total budget plan)	(99.1)	(0.6)	(0.3)				(32.3)
Marshall Space Flight Center	1 121 100	1 276	17 090	400	0	0	1 139 866
(% of total budget plan)	(98.4)	(0.1)	(1.5)	*			(28.7)
Space Nuclear Propulsion Office	0	0	49 700	0	0	0	49 700
(% of total budget plan)			(100.0)				(1.3)
Wallops Station	0	1 640	535	6 400	0	0	8 575
(% of total budget plan)		(19.1)	(6.2)	(74.6)			(0.2)
Western Support Office	0	11 800	6 506	0	0	0	18 306
(% of total budget plan)		(64.5)	(35.5)				(0.5)
Jet Propulsion Laboratory	800	115 217	23 502	57 200	0	0	196 719
(% of total budget plan)	(0.4)	(58.6)	(11.9)	(29.1)			(5.0)
NASA total	$2 809 200	$552 850	$318 700	$278 850	$10 000	$4000	$3 970 600
(% of total budget plan)	(70.8)	(13.9)	(8.0)	(7.0)	(0.3)	(0.1)	(100.0)

*=Less than 0.1%. Because of rounding, percentages may not add to 100.0.

Source: NASA, *Budget Estimates, Fiscal Year 1969*, I, SA–2.

Office and the Launch Operations Center, renamed on December 23, 1963, the John F. Kennedy Space Center, NASA. On October 1, 1965, Pacific Launch Operations Office was disestablished and all NASA launch responsibilities, except for Scout vehicle launches (supervised by Langley Research Center), were consolidated under Kennedy Space Center.

In late 1961 NASA began efforts to remedy a remaining gap in its in-house technical competence. Space flight experience had shown a need for increasing capabilities in electronics research and technology, and NASA's Office of Advanced Research and Technology recommended establishment of a new center specializing in this field. In January 1963, the NASA FY 1964 budget request sent to Congress included $5 million to begin the new installation and on September 1, 1964, Electronics Research Center was officially established in Cambridge, Massachusetts.

Providing administrative and other support for these field installations were several NASA field offices–the Wright-Patterson Air Force Base Liaison Office, Western Support Office (which evolved from a small NACA California liaison office), NASA Pasadena Office, NASA North Eastern Office, and NASA Office-Downey. By mid-1968 all these offices had been disestablished except the NASA Pasadena Office, which administered the contract with California Institute of Technology for the operation of Jet Propulsion Laboratory.

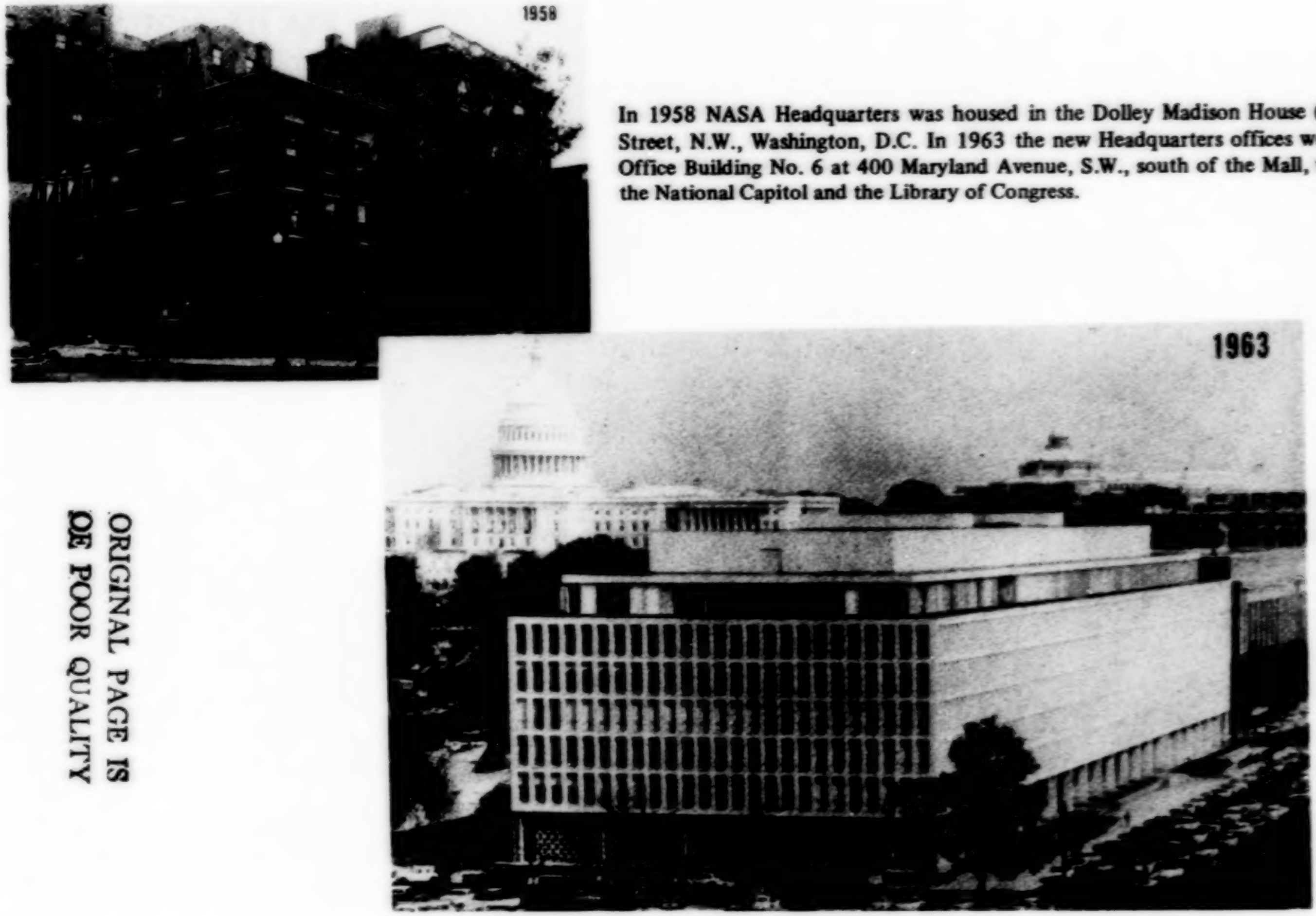
Division of effort among the Centers in the early years of NASA was based on an unavoidable distinction between the established Centers that were formerly NACA-operated and the rapidly growing new Centers. Langley, Ames, Lewis, and Flight–occupied with advanced research and technology studies–were thought of as "research" Centers, while Goddard and Marshall (the new "space flight" Centers), Manned Spacecraft Center, and Jet Propulsion Laboratory were considered principally "development" Centers. During this period the development Centers were encouraged to devote a portion of their resources to supporting research, and research Centers were assigned specific development projects closely related to their fields. Lewis's Centaur project, Ames' Pioneer project, and Langley's Scout project were examples of this project distribution.

For an initial period of two years following the manned lunar landing decision, Center directors were placed under the Associate Administrator to clarify and strengthen his central position as general manager. When the program expansion demanded further refinement of the functional management structure in Headquarters to operate the complex programs as a whole, the field installations began in late 1963 to report directly to Associate Administrators of Headquarters program offices, rather than to general management. After November 1963, Marshall, Manned Spacecraft, and Kennedy Space Centers reported to the Office of Manned Space Flight; Goddard, Wallops, Jet Propulsion Laboratory, and Pacific Launch Operations Office reported to the Office of Space Science and Applications; and Ames, Flight, Langley, and Lewis reported to the Office of Advanced Research and Technology. Based on primary program activity of the installation, rather than on a distinction between research and development work, this organizational lineup was still effective in mid-1968. The proportion of work performed by the Centers in each major program area during FY 1968 is indicated in Table 6-a.

This chapter presents data on Headquarters and current NASA field installations arranged alphabetically. Installations that no longer exist are grouped in the section of former field activities. Information on location, land, and leadership; a summary history, documented to a list of sources; and tables on property, personnel, finances, and procurement are given for each installation and its components. These tables offer an installation-by-installation look at data presented for NASA as a whole in other chapters of the book. Definitions of terms used in the tables of Chapter Six may be found in introductions to pertinent preceding chapters.

Tables listing recipients of NASA incentive and contributon awards are given at the end of each installation section. These lists represent, within the limitations of the present volume, a partial substitute for two elements of an installation's history not examined here—the people and their activities. Future program and Center histories should provide the detail omitted in this chapter.

NASA HEADQUARTERS



In 1958 NASA Headquarters was housed in the Dolley Madison House (left), 1520 H Street, N.W., Washington, D.C. In 1963 the new Headquarters offices were in Federal Office Building No. 6 at 400 Maryland Avenue, S.W., south of the Mall, with a view of the National Capitol and the Library of Congress.

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NASA HEADQUARTERS
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Location: Washington, D.C.

Land: None. As of June 30, 1968, NASA Headquarters occupied all or part of the following Government-owned, GSA-leased, or contractor-leased buildings:

Federal Office Building No. 6, 400 Maryland Ave., S.W.
Federal Office Building No. 10B, 600 Independence Ave., S.W.
Reporters Building, 300 7th Street, S.W.
Temporary E, 4th Street and Adams Drive, S.W.
Building at 1100 17th Street, N.W. (contractor-leased).
Van Ness Center, 4301 Connecticut Ave., N.W. (contractor-leased).
NASA Warehouse, 1411 South Fern Street, Arlington, Va.
NASA Scientific and Technical Information Facility, 5007-09 Calvert Street, College Park. Md.

Administrator: Thomas O. Paine (Oct. 7, 1968- , Acting Administrator).
James E. Webb (Feb. 14, 1961-Oct. 7, 1968).
T. Keith Glennan (Aug. 19, 1958-Jan. 20, 1961).

Deputy Administrator:
Thomas O. Paine (March 25, 1968-Oct. 7, 1968).
Robert C. Seamans, Jr. (Dec. 21, 1965-Jan. 5, 1968).
Hugh L. Dryden (Sept. 19, 1958-†Dec. 2, 1965).

Associate Administrator.
Homer E. Newell (Oct. 1, 1967-).
Robert C. Seamans, Jr. (Sept. 1, 1960-Oct. 1, 1967).
Richard E. Horner (June 1, 1959-July 15, 1960).

History

The National Advisory Committee for Aeronautics (NACA) Headquarters moved in June 1954 from 1724 F Street, N.W., to the Wilkins Building at 1512 H Street, N.W.[1] It was still on H Street in the fall of 1957 when the launch of the U.S.S.R.'s *Sputnik I* led to a thorough examination of existing United States space activities and a debate on the Nation's long-range space program, particularly on the extent to which it should be civilian in orientation.[2] NACA management developed space program proposals during early 1958, and on March 5 President Eisenhower approved the recommendations of his Advisory Committee on Government Organization that a civilian space agency be built on the existing NACA structure. On April 2 draft legislation to establish a National Aeronautics and Space "Agency" was sent to Congress, and the NACA was directed to plan the reorientation of its programs, internal organization, and management structure to carry out the new functions to be assigned to NASA.[3]

After the signing of the Space Act on July 29, 1958, the group planning NASA sought additional building space. In September 1958, the first NASA Administrator occupied the newly acquired Dolley Madison House at 1520 H Street, N.W. Built in 1830 by Benjamin Tayloe, this building had been occupied by the wife of President James Madison from 1837 to 1849. Around the turn of the twentieth century, when the building was called the Cosmos Club, it provided temporary quarters in Washington for the Wright brothers. On October 1, 1958, Dolley Madison House officially became the first home of NASA Headquarters.[4]

Between July and October 1961, part of NASA Headquarters moved into the newly completed Federal Office Building No. 6, which it shared with the Department of Health, Education, and Welfare. On November 8, 1963, NASA offices began occupancy of a second new Federal Office Building, No. 10B. Other NASA personnel, who since 1963 had occupied the Universal Building, North, at 1875 Connecticut Avenue, N.W., moved in October and November 1965 to the Reporters Building at 300 7th Street, S.W., near the two NASA-occupied Federal Office Buildings. NASA's Procurement Division vacated the Universal Building in April 1966 for space in No. 10B, and in

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[1] NACA Headquarters had been on F Street since 1948; from 1942 to 1947, it occupied the Leiter Mansion at 1500 New Hampshire Avenue, N.W.; 1920-1941, the Navy Building; 1918-1919, a building at 4th Street and Missouri Avenue; 1916-1917, the Munsey Building; and in 1915, the State, War, and Navy Department Building.

[2] Day book, William M. Thompson, General Systems Branch Chief, NASA Financial Management Division, formerly NACA Fiscal Officer; Rosholt, *Administrative History of NASA*, Chapter One.

[3] Memorandum for the President from the President's Advisory Committee on Government Organization, March 5, 1958; cited in Rosholt, *Administrative History of NASA, 8-10.*

[4] Between 1958 and 1963, NASA occupied not only Dolley Madison House and the Wilkins Building, but at various times used space in buildings at 736 Jackson Place, 801 19th Street, N.W., 1815 H Street, N.W., 7th and D Streets, S.W., and a temporary structure ("Tempo L") near the Lincoln Memorial.

August 1968 the Apollo Program Office left No. 10B to initiate a planned series of moves into L'Enfant Plaza North Building.[5]

This physical expansion reflected the overall growth of NASA. It was also a visible measure of increasingly complex Headquarters functions assumed in the transition from the NACA, with its FY 1958 appropriation of $117.3 million, to an agency with an appropriation of nearly $2 billion by FY 1962, and a peak of $5.3 billion in FY 1965.

Initially, the chief task of Headquarters was to form a unified agency out of disparate entities from the NACA and the Naval Research Laboratory brought together by Executive Order 10783 on October 1, 1958, and subsequent transfers from the U.S. Army of the Jet Propulsion Laboratory and the Development Operations Division of the Army Ballistic Missile Agency. The NACA laboratories had operated with a relatively high degree of autonomy; their program and policy direction had emanated from a small Headquarters organization that permitted many informal and direct contacts.[6]

The NACA had been led by a Director, Executive Secretary, and Associate Director for Research. The first official NASA Headquarters organization retained a trio of top management positions–Administrator, Deputy Administrator, and Associate Administrator. Program activities in 1958 were divided between "research" and "development," but after a little more than a year this distinction was changed to "advanced research" and "space flight," with an additional category for launch vehicle programs. A few months later, a fourth program area of life sciences was established.[7]

In 1961 the importance of Headquarters as central coordinator of the agency's projects was heightened by a national policy decision that clarified the immediate goals of United States efforts in space. On May 25, 1961, President Kennedy urged a joint session of Congress to accelerate the Nation's space program by committing resources to a manned lunar landing before the end of the decade and to development of a nuclear rocket and worldwide applications satellite systems. Congress approved his proposal in authorizations enacted in July and the Appropriations Act for FY 1962 in August 1961.[8]

To implement these national objectives, NASA had to expand. Sudden growth demanded immediate solutions to administrative and program problems of directing interrelated research and development projects. Two basic problems were the demarcation of major program areas and the establishment of effective working relationships between Headquarters and the directors of field Centers.

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[5] U.S. Congress, Senate, Committee on Aeronautical and Space Sciences, *NASA Authorization for Fiscal Year 1964, Hearings*, Pt. 2, 88th Cong., 1st sess., June 12, 13, 17, 18, 1963 (Washington, D.C.: GPO, 1963), 1046-1049; interview with Sidney G. Newman, Buildings Management Branch, NASA Administrative Services Division, July 24, 1968.

[6] Rosholt, *Administrative History of NASA*, 29, 33-34.

[7] Major NASA organization charts are given in Appendix B of this volume. A collection of organization charts 1958-1963 is given in Rosholt, *Administrative History of NASA*, Append. B.

[8] P.L. 87-98, 75 Stat. 216, July 21, 1961, and P.L. 87-141, 75 Stat. 342, Aug. 17, 1961.

NASA Headquarters responded to the 1961 decision by dropping earlier program area distinctions and establishing four new offices for Manned Space Flight, Space Sciences, Applications, and Advanced Research and Technology. At the same time, the Center directors were placed organizationally directly under the Associate Administrator to strengthen the control of general management. Initial steps to improve staff services to general management also were taken in 1961 by setting up staff offices for Programs and Administration. Division directors in the Headquarters Office of Administration were to serve as functional managers, responsible for high standards of performance in their own areas of specialization throughout NASA and its field installations.[9]

After two years the gain in central control permitted further refinement of the Headquarters organizational structure. After November 1963, Center directors reported directly to program offices instead of to general management, and program office directors were given the title of Associate Administrator for their respective areas.[10] By combining the Office of Applications with the Office of Space Sciences, the program offices were reduced to three, but eventually the Office of Tracking and Data Acquisition became a fourth program office.[11] This group of four was still the same in mid-1968.

With a stable lineup of program offices, organizational planning after 1963 effected a series of realignments in staff offices designed to facilitate the flow of accurate information to the top. By 1968 two new major management positions had evolved to deal with internal and external matters. An Associate Administrator for Organization and Management was placed over staff offices concerned chiefly with internal problems, while an Associate Deputy Administrator managed staff offices concerned with international, legislative, and public affairs.[12]

In addition to the well-known programs managed by Headquarters offices and the normal administrative workload of any large organization, in 1968 Headquarters functions included handling relations with Congress, the Department of Defense, and other Government agencies; patent issues arising from NASA-sponsored investigations; negotiation and review of special contracts; labor relations; contracts with the academic community dealt with by a special Office of University Affairs; and quick dissemination of technical information through the work of the Office of Technology Utilization.

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[9] NASA Announcement 314, June 5, 1961; NASA Release 61-213, Sept. 24, 1961; Rosholt, *Administrative History of NASA*, 297.

[10] NASA Release 63-225, Oct. 9, 1963.

[11] NASA Release 66-3, Jan. 2, 1966. The Office of Tracking and Data Acquisition had previously been lined up with the other program offices by an organization chart effective from April 26, 1963, through Nov. 1, 1963.

[12] NASA Releases 67-49 and 67-50; NASA Management Instruction 1101.1A, Attachment A, May 1, 1968.

The growing Headquarters personnel complement assembled to carry out these functions can be traced along with the expansion of the physical plant and the refinement of the organizational structure. In the fall of 1958 when the NACA became the National Aeronautics and Space Administration, only 180 persons were employed in NASA Headquarters—a little over two percent of the 7966 total paid employees. The permanent staff included nine persons holding excepted positions and 37 aeronautical research scientists and engineers.

The largest annual increment in personnel came soon after the manned lunar landing decision; between December 1961 and December 1962, Headquarters permanent personnel increased by 78 percent, from 922 to 1641. The total number of NASA permanent employees peaked at 33 722 in the period ending December 31, 1966. On that date, NASA Headquarters reported 2152 permanent employees—more than six percent of the agency total. Of these 2152 persons, 160 held excepted positions and 561 were classified as scientists or engineers. Because of budget restrictions, Headquarters had reduced its permanent staff to 2077 by June 30, 1968.[13]

Mission

As of 1968 the mission of NASA Headquarters was to plan and provide executive direction for programs authorized by the Congress, implementing the national objectives stated in the National Aeronautics and Space Act of 1958, as amended:

(1) Conducting research into, and for the solution of, problems of flight within and outside the earth's atmosphere and developing, constructing, testing, and operating aeronautical and space vehicles for research;

(2) conducting activities required for the exploration of space with manned and unmanned vehicles;

(3) Arranging for participation by the scientific community in planning scientific measurements and observations to be made through use of aeronautical and space vehicles and conducting or arranging for the conduct of measurements and observations;

(4) Providing for the widest practicable and appropriate dissemination of information concerning its activities and the results.

The following offices in Headquarters assisted management in carrying out the technical aspects of this mission.

Office of Manned Space Flight—As of 1968 OMSF was responsible for all NASA activities directly related to manned space flight missions. The Office of Manned Space Flight held launch responsibility for all major manned and unmanned missions utilizing the three installations primarily concerned with the manned space flight programs:

(1) George C. Marshall Space Flight Center, including Michoud Assembly Facility, Computer Operations Office, and Mississippi Test Facility;

(2) Manned Spacecraft Center, including White Sands Test Facility;

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[13] NASA Personnel Division. For additional data on Headquarters personnel, see Table 6-2 and Chapter Three.

(3) John F. Kennedy Space Center, including NASA activities at the Eastern and Western Test Ranges.

Office of Space Science and Applications–OSSA was responsible for the NASA automated space flight program directed toward scientific investigations of the earth, moon, sun, planets, and interplanetary space utilizing ground-based, airborne, and space techniques such as sounding rockets, earth satellites, and deep space probes; for scientific experiments to be conducted by man in space and selection and training of astronaut-scientists; for research and development of space flight applications in such areas as meteorology, communications, navigation, geodesy, and earth resources surveys, and for the support of operational systems using these developments; and for the development, procurement, and use of light- and medium-class launch vehicles, such as Centaur. The Office of Space Science and Applications had an over-all institutional responsibility for the NASA installations primarily working in space science and applications programs:

(1) Goddard Space Flight Center,

(2) Wallops Station,

(3) Jet Propulsion Laboratory (Government-owned facility operated for NASA by California Institute of Technology),

(4) NASA Pasadena Office (a component field activity of Headquarters).

Office of Advanced Research and Technology–As of 1968 OART was responsible for the planning, direction, execution, evaluation, documentation, and dissemination of the results of all NASA research and technology programs conducted primarily to demonstrate the feasibility of a concept, structure, component, or system which might have general application to the Nation's aeronautical and space objectives; and for coordinating NASA's supporting research and technology program. The Office of Advanced Research and Technology had over-all institutional responsibility for the research Centers primarily carrying out NASA's advanced research programs:

(1) Ames Research Center,
(2) Electronics Research Center,
(3) Flight Research Center,
(4) Langley Research Center,
(5) Lewis Research Center,
(6) Space Nuclear Propulsion Office.

Office of Tracking and Data Acquisition–OTDA was responsible for the development, implementation, and operation of tracking, data acquisition, communications, and data-processing facilities, systems, and services required for NASA flight systems; and for coordination of the management of automatic data-processing systems and services.

Table 6–1. Capitalized Equipment Value
(as of June 30; in thousands)

1962[a]	1963	1964	1965	1966	1967	1968
$1340	$1735	$1658	$2513	$6083	$7302	$10 210

[a] Data for earlier years are not available.

Source: NASA, Office of Facilities.

Table 6–2. Personnel

	1958		1959		1960		1961		1962		1963	
	9/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31[a]
Requested for FY ending			200[e]		488[f]		715[g]		951		1900	
Total,paid employees	180	274	429	484	585	662	748	960	1477	1693	2001	2017
Permanent	176	267	420	477	561	645	716	922	1321	1641	1846	1952
Temporary	4	7	9	7	24	17	32	38	156	52	155	65
Code group (permanent only)												
200[b]	2	2	4	5	8	7	11	8	9	9	11	13
700[c]	35	55	101	115	121	154	176	213	320	443	505	528
900	0	0	0	0	0	0	0	0	0	0	0	2
Subtotal	37	57	105	120	129	161	187	221	329	452	516	543
600[d]	0	0	0	0	0	167	203	274	411	488	549	620
500	134	202	302	343	415	300	306	398	545	660	733	742
300	1	1	4	4	5	5	8	14	19	24	27	27
100	4	7	9	10	12	12	12	15	17	17	21	20
Subtotal	139	210	315	357	432	484	529	701	992	1189	1330	1409
Excepted: on duty	9	46	68	72	88	96	100	108	133	156	162	154
Accessions: permanent	375	107	147	75	135	1412	107	251	435	369	318	246
Accessions: temporary	86	7	11	13	23	281	43	27	123	39	130	79
Military detailees	0	0	0	0	0	11	13	21	26	25	32	34

Table 6-2. Personnel (Continued)

	1964		1965		1966		1967		1968
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Requested for FY ending	2300		2100		2156		2135		2611
Total, paid employees	2158	2026	2135	2112	2336	2274	2373	2176	2310
Permanent	1978	1966	1998	2019	2081	2152	2138	2093	2077
Temporary	180	60	137	93	255	122	235	83	233
Code group (permanent only)									
200[b]	12	10	13	14	13	14	13	9	9
700[c]	516	509	522	530	531	544	538	542	530
900	4	4	4	3	3	3	2	2	2
Subtotal	532	523	539	547	547	561	553	553	541
600[d]	663	693	700	708	731	791	788	802	801
500	745	717	729	740	775	767	761	709	707
300	18	15	13	7	8	7	11	8	8
100	20	18	17	17	20	26	25	21	20
Subtotal	1446	1443	1459	1472	1534	1591	1585	1540	1536
Excepted: on duty	157	166	147	154	153	160	159	169	177
Accessions: permanent	118	135	144	169	222	235	162	NA	NA
Accessions: temporary	152	40	101	91	196	30	104	NA	NA
Military detailees	33	40	40	37	33	32	30	24	23

[a] Includes Electronics Research Task Group.

[b] Beginning June 30, 1961, the data reflect conversion of some professionals from the 200 occupational code group (engineers) to the 700 code group (aerospace technologists). For key to code group numbers and definition of terms, see Chapter Three.

[c] Data before June 30, 1961, are for "aeronautical research scientists." Beginning June 30, 1961, the data reflect conversion of these personnel members to the 700 code group (aerospace technologists).

[d] Before Dec. 31, 1960, the data reflect inclusion of code group 600 personnel in the 500 code group.

[e] In addition to NACA request.

[f] Includes 2 positions for the Wright-Patterson Liaison Office.

[g] Includes 26 positions for Atlantic Missile Range Operations Office and 6 for Pacific Missile Range Office.

NA = Data not available.

Source: NASA Personnel Division. Data through Dec. 31, 1966, from NASA Quarterly Personnel Statistical Report; data after Dec. 31, 1966, from Personnel Management Information System and the NASA supplement to SF 113-A, "Monthly Report of Federal Civilian Employment Short Form."

Table 6-3. Distribution of Permanent Personnel Positions by Fiscal Year and Budget Activity[a]

Activity	1959[b]	1960[b]	1961	1962	1963	1964	1965	1966	1967	1968
Manned space flight	–	–	147	567	437	419	453	578	459	409
(% of total)	(2.9)	(16.0)	(19.6)	(41.7)	(23.6)	(20.0)	(20.9)	(22.3)	(18.4)	(19.0)
Space applications	–	–	84	58	27	37	41	48	57	51
(% of total)	(1.0)	(3.0)	(11.2)	(4.3)	(1.5)	(1.8)	(1.9)	(1.9)	(2.3)	(2.4)
Unmanned investigations in space	–	–	243	287	147	159	184	225	256	186
(% of total)	(1.9)	(7.0)	(32.4)	(21.2)	(8.0)	(7.6)	(8.5)	(8.7)	(10.2)	(8.6)
Space research and technology	–	–	179	279	158	189	190	207	203	176
(% of total)	(15.4)	(24.0)	(23.8)	(20.5)	(8.6)	(9.0)	(8.8)	(8.0)	(8.1)	(8.2)
Aircraft technology[c]	–	–	56	41	22	22	27	27	33	30
(% of total)	(77.9)	(46.0)	(7.4)	(3.0)	(1.2)	(1.1)	(1.3)	(1.0)	(1.3)	(1.4)
Supporting activities[d]	–	–	42	128	1056	1265	1268	1507	1491	1302
(% of total)	(0.9)	(4.0)	(5.6)	(9.4)	(57.2)	(60.5)	(58.6)	(58.1)	(59.7)	(60.4)
Total	–	–	751	1360	1847	2091	2163	2592	2499	2154

[a] Based on number of actual positions reported in annual NASA Budget Estimates. FY 1961 actual figure was reported in NASA, *Budget Estimates, FY 1963*; FY 1962 actual figure was reported in NASA, *Budget Estimates, FY 1964*; etc.

[b] Actual positions data are not available for FY 1959 and FY 1960. Percentages in these two columns are based on distribution used by NASA Office of Programming, Budget Operations Division, in preparing *History of Budget Plans, Actual Obligations, and Actual Expenditures for Fiscal Years 1959 Through 1963* (Washington, D.C.: NASA, 1965), Section 8.

[c] FY 1961 figure represents "Aircraft and missile technology."

[d] FY 1963 and later figures include tracking and data acquisition, sustaining university program, technology utilization, and general support positions. Until FY 1963, general support positions were reported with the five other budget activities. FY 1961 figure represents tracking and data acquisition only, and FY 1962 figure represents tracking and data acquisition plus technology utilization (reported as "Industrial applications").

Source: NASA, *Budget Estimates*, FY 1963-FY 1969; NASA, Budget Operations Division.

Table 6-4. Funding by Fiscal Year
(program plan as of May 31, 1968, in millions)

Appropriation Title	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total
Research and development	$112.30	$157.70	$70.20	$55.50	$136.70	$158.60	$179.90	$171.00	$157.40	$336.70	$1536.00
Administrative operations[a]	5.67	8.53	13.87	25.95	51.30	47.09	51.76	54.24	57.53	58.44	374.38
Total	$117.97	$166.23	$84.07	$81.45	$188.00	$205.69	$231.66	$225.24	$214.93	$395.14	$1910.38

[a] FY 1959-1962 appropriations were for salaries and expenses; FY 1963 appropriation was for research, development, and operation.

Source: NASA, Office of Programming, Budget Operations Division, *History of Budget Plans, Actual Obligations, and Actual Expenditures for Fiscal Years 1959 Through 1963* (Washington, D.C.: NASA, February 1965); NASA, Budget Operations Division, "Status of Approved Programs," FY 1959-FY 1968, May 1968.

Table 6-5. Total Procurement Activity by Fiscal Year
(money amounts in millions)

	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total
Net value of contract awards	$116.1	$25.3	$67.7	$155.1	$189.0	$209.0	$187.1	$168.9	$436.1[a]	$1554.3
Percentage of NASA total	34%	3%	4%	5%	4%	4%	4%	3.6%	10.6%	5.3%

[a] This figure includes 1968 NASA Pasadena Office total.

Source: NASA, Procurement and Supply Division, *NASA Procurement: October 1, 1958 to June 30, 1960* (Washington, D.C.: NASA, September 1960); NASA, *Annual Procurement Report*, Fiscal Years 1961-1968 (Washington, D.C.: NASA, 1962-1968).

NASA DAYTONA BEACH OPERATION

Location: Daytona Beach, Volusia County, Florida.

Resident Manager: S. S. Schneider (Jan. 7, 1963-).

History[1]

On December 1, 1962, NASA established a Headquarters NASA Plant Officer at the General Electric Company, Daytona Beach, Florida.[2] The office was officially opened February 4, 1963.

NASA Daytona Beach Operation was established June 23, 1963, as an integral part of NASA Launch Operations Center (redesignated John F. Kennedy Space Center, NASA, December 20, 1963).[3] On April 15, 1965, Daytona Beach Operation was placed under the NASA Headquarters Office of Manned Space Flight, with the Resident Manager reporting directly to the Director of the Apollo Program.[4]

Mission

The mission of the Daytona Beach Operation was to provide a focal point for NASA and Department of Defense representation at the General Electric Company, Apollo Systems Department:

(1) Furnishing administrative support and services to all elements of Headquarters program offices, field installations, project offices, and other NASA-DOD activities in residence at the plant;

(2) Providing support in planning and coordinating the overall role of the contractor in NASA programs;

(3) Providing local technical guidance, inspection and quality assurance, production planning and control;

(4) Exercising contract administration authority as delegated by contracting officers and coordinating matters of mutual interest with other NASA elements;

(5) Representing NASA with DOD field agencies that provided services (such as security) to NASA in connection with the operation of the contractor.[5]

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[1] This section was prepared by S. S. Schneider, NASA Daytona Beach Operation.

[2] NASA Circular 267, Dec. 1, 1962.

[3] NASA Circular 267A, June 23, 1963; KSC Release 67-64.

[4] NASA Management Instruction 1138.2, April 15, 1965.

[5] NASA Management Instruction 1138.2A, Sept. 29, 1966.

Table 6-6. Personnel: NASA Daytona Beach Operation
(total paid employees)

1963		1964		1965	
6/30	12/31	6/30	12/31	6/30	12/31
8	15	28	34	32	32

1966		1967		1968	
6/30	12/31	6/30	12/31	6/30	
32	32	31	30	33	

Source: Kennedy Space Center, Professional Staffing and Examining Branch.

NASA PASADENA OFFICE
(NaPO)

Location: Pasadena, Los Angeles County, California.

Director: Earle J. Sample (Oct. 19, 1965-).
Paul E. Ross (Director, NASA Resident Office-JPL, March 12, 1964-Oct. 19, 1965; Manager, WOO NASA Residency-JPL, April 8, 1963-March 12, 1964).

History[1]

Management of the contract with the California Institute of Technology for operation of the Jet Propulsion Laboratory became a NASA responsibility December 3, 1958.[2] The initial NASA contract was negotiated by Headquarters with local day-to-day administration decisions delegated to a Contracting Officer's Representative in the U.S. Army Ordnance District, Los Angeles. Major administrative approvals and decisions were assigned to the Procurement Officer at Ames Research Center, who visited JPL one or two days a week.[3] Beginning January 1, 1960, responsibility for negotiation and contract administration was delegated to the new Procurement and Contracting Division of the Western Operations Office (WOO), Santa Monica, California.[4] On February 1, 1962, a Contracting Officer's Representative, assisted by a staff of three, was placed in residence at JPL as an extension of the Contracts Management Division (as it was called then) of the Western Operations Office. He was designated Manager, NASA Residency-JPL,[5] and was given the duties formerly delegated to Army Ordnance and the Procurement Officer at Ames Research Center. His function was day-to-day contract administration. Responsibility for negotiation of the master contract between NASA and Caltech and major changes to it remained a responsibility of the Procurement Officer in the Contracts Management Division, Western Operations Office.

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[1] This section was prepared by Earle J. Sample and his staff at the NASA Pasadena Office.

[2] Executive Order 10793, Dec. 3, 1958, Subject: Transferring Certain Functions from the Department of Defense to the National Aeronautics and Space Administration.

[3] Letter, Ralph E. Cushman, Contracting Officer, NASA Hq., to Col. Paul H. Scordas, Commanding Officer, U.S. Army Ordnance District, Jan. 22, 1959, Subject: Appointment as Contracting Officer's Representative, Contract No. NASw-6; Letter, C.D. Gang, Contracting Officer's Representative, Army Ordnance, to NASA, June 11, 1959, Subject: Power of Attorney under Contract at California Institute of Technology/Jet Propulsion Laboratory, National Aeronautics and Space Administration Contract NASw-6.

On April 8, 1963, the staff was increased to 10 persons and the Residency was detached from the Contracts Management Division and assigned to the Director, Western Operations Office. Later in 1963, the staff was increased to 17 persons. On March 12, 1964, NASA established the NASA Resident Office-JPL (NRO-JPL), and the new office reported directly to the NASA Headquarters Associate Administrator for Space Science and Applications.[6] Responsibility for negotiation with Caltech remained with the Contracts Management Division, Western Operations Office.

With the emergence of the Voyager program as a major activity and the decision to assign project management to JPL, with procurement of major system contracts directly by NASA, the Deputy Administrator directed on October 19, 1965, that certain elements of the WOO procurement and contract administration staff be relocated to Pasadena "to form a NASA Voyager Procurement Management Group (VPMG)" and that "certain other procurement functions currently performed by WOO . . . should be relocated to Pasadena . . . ." These two groups, plus the JPL contract administration group already in Pasadena, would report to a "single NASA Resident Representative and . . . overall Director of NASA contract activities . . . ."[7]

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[4] Letter, Cushman, NASA Hq., to Commanding Officer, Army Ordnance, Nov. 12, 1959, Subject: Contract Administration–Designation of NASA Western Operations Office Representatives; Letter, Cushman, NASA Hq., to WOO, Attn. Earle J. Sample, Nov. 12, 1959, Subject: Contract Administration–Designation of NASA Western Operations Office Representatives; Letter, Cushman, NASA Hq., to Commanding Officer, Army Ordnance, Jan. 21, 1959, Subject: Appointment as Contracting Officer's Representative, Contract No. NASw-6; Letter, Cushman, NASA Hq., to WOO, Attn. Earle J. Sample, June 6, 1961, Subject: Revisions to Contract NASw-6. For a brief history of WOO and WSO, see the section Former Field Activities in Chapter six.

[5] Memorandum, Earle J. Sample, Chief Contracts Management Division, WOO, for Director, WOO, Jan. 23, 1962, Subject: Contracts Administration Division Reorganization.

[6] NASA Management Instruction 2-2-17, March 12, 1964, Subject: Establishment and Functions of the NASA Resident Office-JPL.

[7] Memorandum, Dr. Robert C. Seamans, Jr., NASA Associate Administrator, to Associate Administrator for Space Science and Applications and Deputy Associate Administrator for Industry Affairs, Oct. 19, 1965, Subject: Prime Contracting Arrangements for Voyager.

This action joined three procurement activities and constituted the new NASA Pasadena Office formalized August 8, 1966.[8]

An initial cadre of 10 relocated to Pasadena from WOO October 21, 1965, grew to a total of 89 in 1966; 15 persons were assigned full-time to the Voyager program until it was canceled November 1, 1967. With cuts in the FY 1968 budget, some elements of the Western Operations Office were made a part of the NASA Pasadena Office. WOO was disestablished and NaPO was substantially reduced to 76 persons.[9]

Mission

The Pasadena Office's mission was negotiating, executing, and administering NASA contracts with the California Institute of Technology for the operation of the Jet Propulsion Laboratory; providing procurement, contract administration, and related services in support of the Office of Space Science and Applications (OSSA) and other NASA organizational elements; conducting a public affairs program in the western United States; and operating the western terminus of the NASA teletype network.[10]

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[8] NASA Management Instruction 1138.9, Aug. 8, 1966, Subject: Functions and Authority–NASA Pasadena Office.

[9] NASA Release 67-292; Memorandum, Harold B. Finger, NASA Associate Administrator for Organization and Management, to NASA Administrator James E. Webb, Nov. 15, 1967, Subject: A Plan for Consolidation of Activities at WSO and NaPO; Memorandum, Finger to Earle J. Sample, Director, NaPO, Nov. 21, 1967, Subject: WSO-NaPO Task Force; Proposed NASA Management Instruction 1138.9A [n.d.], Subject: Functions and Authority–NASA Pasadena Office.

[10] NASA Management Instruction 1138.9.

Table 6-7. Industrial Real Property: NASA Pasadena Office–JPL
(as of June 30; money amounts in thousands)[a]

Facility	Land in Hectares (and acres) 1967	Land in Hectares (and acres) 1968	Number of Buildings 1967	Number of Buildings 1968	Buildings in Square Meters (and sq ft) 1967	Buildings in Square Meters (and sq ft) 1968	Land Value 1967	Land Value 1968
Jet Propulsion Laboratory (Contract NAS 7–270 F)	59.1 (145.9)	59.1 (145.9)	121	207	117 741.9 (1 267 364)	129 112.0 (1 389 750)	$799	$799
Goldstone Space Communications Station	0	0	28	36	7 792.1 (83 872)	8 362.4 (90 012)	0	0
Table Mountain Observatory	0	0	11	10	445.2 (4 792)	497.9 (5 359.0)	0	0
Edwards Test Site	0	0	29	32	3 511.3 (37 795)	3 669.9 (39 503)	0	0
Total	59.1 (145.9)	59.1 (145.9)	189	285	129 490.4 (1 393 823)	141 642.2 (1 524 624)	$799	$799

Facility	Buildings Value 1967	Buildings Value 1968	Other Structures and Facilities Value 1967	Other Structures and Facilities Value 1968	Total Real Property Value 1967	Total Real Property Value 1968
Jet Propulsion Laboratory (Contract NAS 7–270 F)	$34 877	$41 102	$4 770	$ 5 084	$40 446	$46 985
Goldstone Space Communications Station	2 258	2 923	3 364	17 798	5 622	20 721
Table Mountain Observatory	180	170	116	189	296	359
Edwards Test Site	1 228	1 373	1 028	1 176	2 256	2 549
Total	$38 543	$45 568	$9 278	$24 247	$48 620	$70 614

[a] For data on JPL property over 10 years, see section on JPL in this chapter. This table does not include data on DSN tracking stations other than Goldstone; figures for the other stations for FY 1968 are: number of buildings, 58; square meters of buildings, 17 915.4 (192 840 sq ft); buildings value, $5 040 000; other structures and facilities value, $3 268 000; and total real property value, $8 308 000. Comparable data are not available for FY 1967. For breakdown of DSN tracking stations' total real property for FY 1967 and FY 1968, see Table 2-23 in Chapter Two.

Source: NASA, Office of Facilities.

Table 6–8. Personnel: NASA Pasadena Office

Classification	1964 12/31	1965 6/30	1965 12/31	1966 6/30	1966 12/31	1967 6/30	1967 12/31	1968 6/30
Total, paid employees[a]	16	19	20	85	87	91	87	79
Permanent	16	18	20	79	87	86	87	76
Temporary	0	1	0	6	0	5	0	3
Code group (permanent only)[a]								
200	0	0	0	0	0	0	0	1
700	2	3	3	8	8	9	9	8
600	9	10	11	43	49	48	48	39
500	5	5	6	28	30	29	30	28
Excepted: on duty	0	0	0	1	1	1	1	1
Military detailees	0	0	0	0	0	0	0	14

[a] For definition of terms and Code group classifications, see Chapter Three.

Source: NASA, Personnel Division. Data through Dec. 31, 1966, from NASA Quarterly Personnel Statistical Report; data after Dec. 31, 1966, from NASA Personnel Management Information System and the NASA Supplement to SF 113–A, "Monthly Report of Federal Civilian Employment Short Form."

Table 6–9. Funding by Fiscal Year: NASA Pasadena Office
(program plan as of May 31, 1968; in millions)

Appropriation Title	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total
Research and development[a]	–	–	–	–	$184.10	$202.30	$225.90	$213.60	$188.50	$1014.40
Construction of facilities[b]	$7.73	$8.56	$3.58	$11.43	3.00	3.58	.94	.35	1.93	41.10
Administrative operations[c]	–	–	–	–	–	17.47	.88	1.66	1.78	21.79
Total	$7.73	$8.56	$3.58	$11.43	$187.10	$223.35	$227.72	$215.61	$192.21	$1077.29

[a] Data for FY 1963 and prior years included in Western Support Office figures.
[b] Does not include facilities planning and design.
[c] Data for FY 1964 and prior years included in Western Support Office figures.

Source: NASA, Office of Programming, Budget Operations Division, *History of Budget Plans, Actual Obligations, and Actual Expenditures for Fiscal Years 1959 Through 1963* (Washington, D.C.: NASA, February 1965); NASA, Budget Operations Division, "Status of Approved Programs," FY 1959–FY 1968, May 1968.

Table 6-10. Total Procurement Activity by Fiscal Year: NASA Pasadena Office
(money amounts in millions)

	1966	1967	1968	Total
Net value of contract awards[a]	$337.2	$327.3	*	$664.5
Percentage of NASA total	7%	7%		2.3%

[a] Figures include contract with Jet Propulsion Laboratory.

*1968 amount included in NASA Headquarters total.

Source: NASA, Procurement and Supply Division, *NASA Procurement: October 1, 1959 to June 30, 1960* (Washington, D.C.: NASA, September 1960); NASA, *Annual Procurement Report*, Fiscal Years 1961-1968 (Washington, D.C.: NASA, 1962-1968).

AMES RESEARCH CENTER

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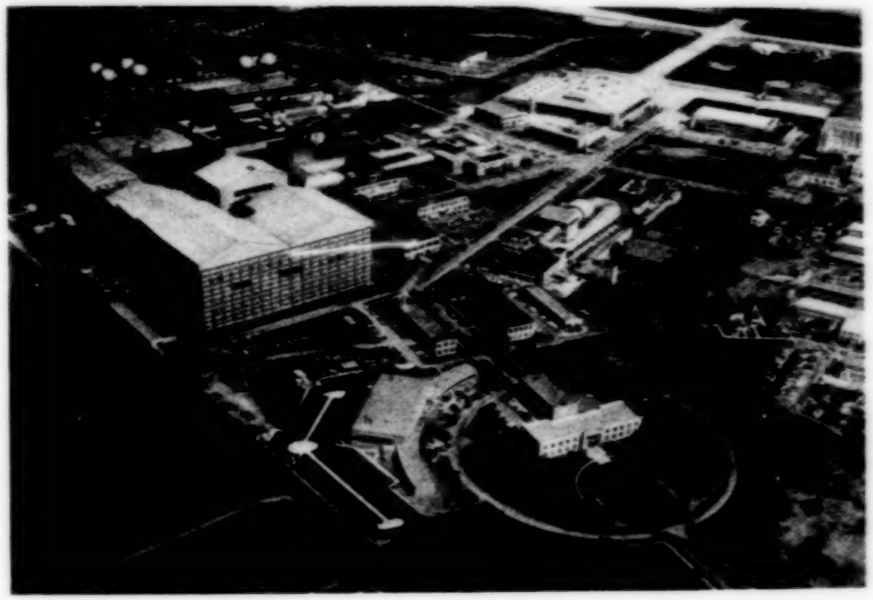

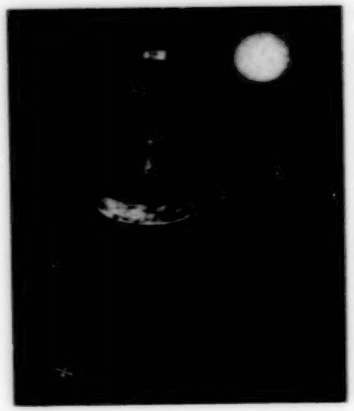

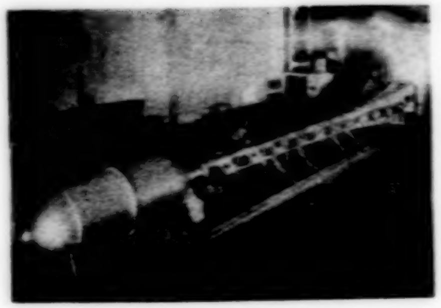

Ames Research Center, Moffett Field, California, photographed from the air in 1963. ARC's mission responsibility has included *Pioneer 6* (upper right; launched Dec. 16, 1965, as the first of a series of deep space probes), VTOL research with the fan-in-wing Ryan jet aircraft (near right) beginning in 1968, and reentry testing in the Atmosphere Entry Simulator (lower far right).

ORIGINAL PAGE IS
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AMES RESEARCH CENTER
(ARC)

Location: Mountain View, Santa Clara County, California.

Land: 148.4 hectares (366.6 acres), total as of June 30, 1968:
- 147.9 hectares (365.5 acres) NASA-owned.
- 0.5 hectares (1.1 acres) leased.
- Acquisition of two additional parcels of 9.5 and 13.0 hectares (23.5 and 32.0 acres) under consideration.

Director: H. Julian Allen (Oct. 15, 1965-).
Smith J. DeFrance (Oct. 1, 1958-Oct. 15, 1965; Director, NACA Ames Aeronautical Laboratory, June 24, 1947-Oct. 1, 1958; Engineer-in-Charge, NACA Ames Aeronautical Laboratory, July 25, 1940-June 24, 1947).

Associate Director:
John F. Parsons (Oct. 1, 1958- ; Associate Director NACA Ames Aeronautical Laboratory, Aug. 1, 1952-(Oct. 1, 1958).

History[1]

The second National Advisory Committee for Aeronautics laboratory was authorized by Congress August 9, 1939. A Special Survey Committee on Aeronautical Research Facilities headed by Col. Charles A. Lindbergh evaluated 54 proposed locations, and the NACA announced selection of the 40.9-hectare (101-acre) Moffett Field site September 22.[2] Moffett Field had been a Navy rigid-airship base before its transfer to the Army in October 1935 for use as an air training base.[3] In April 1942 the Navy reacquired the property, recommissioning it Moffett Naval Air Station.[4] Ground was broken December 20, 1939, for the first NACA building on the site, and John F. Parsons arrived January 29, 1940, to supervise construction.[5]

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[1] This section was prepared by Manley J. Hood with additional information provided by William P. Peterson, both of Ames Research Center.

[2] Edwin P. Hartman, *Adventures in Research: A History of Ames Research Center, 1940-1965* (Washington, D.C.: NASA SP-4302, 1970), Pt. 1, Chap. 4; *Twenty-Fifth Annual Report of the NACA, 1939* (Washington, D.C.: GOP, 1940), 38-39. The original site consisted of 25.1 hectares (62 acres) granted Dec. 7, 1939, on revocable use permit from the U.S. War Department and 15.932 hectares (39.369 acres) of purchased land deeded Dec. 15, 1939.

The name "Ames Aeronautical Laboratory," proposed to the NACA by Dr. Edward P. Warner, honored Dr. Joseph S. Ames (1864-1943), NACA Chairman from 1927 to 1939. On April 18, 1940, at a luncheon commemorating the NACA's 25th anniversary, the name was announced to the public.[6]

Smith J. DeFrance, Engineer-in-Charge, arrived August 20, 1940, and flight research was under way by 1941. The first research report, dated April 1941, was a study of methods to protect aircraft from icing hazards. On March 13, 1941, 7- by 10-foot wind tunnel No. 1 (the first of two) ran for the first time and in August, when the 16-foot tunnel made its first calibration tests, both 7- by 10-foot tunnels began their first research programs (the 16-foot was converted to the 14-foot transonic tunnel in 1955). On June 8, 1944, upon completion of the 40- by 80-foot wind tunnel and the Administration Building, the facility was formally dedicated.[7]

Renamed "Ames Research Center" October 1, 1958, when it became part of NASA, the laboratory, with about one third of its research already space related, gradually expanded its efforts to cover new areas of space research. In February 1961, Ames' life science research activity began,[8] and the installation undertook space-project management for the first time November 9, 1962, when it was assigned responsibility for the Pioneer project. Biosatellite project management also was assigned to Ames February 13, 1963,[9] but management of space flight projects remained a minor portion of its work.

In addition to managing the Pioneer and Biosatellite projects, Ames researchers have been responsible for numerous space flight experiments. Magnetometers, plasma probes, cosmic-dust collection, navigational and control devices, solar emission, thermal-control, and life science experiments were flown on various spacecraft, including Pioneers, Biosatellites, Explorers, OSOs, OGOs, and Gemini. In addition, several Ames experimenters were named to analyze returned lunar material. Much of this research at Ames was stimulated by the formation of the Space Science Division in 1962.

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[3] Hartman, Pt. I, Chap. 5.

[4] *Ibid.*, Chap. 6.

[5] *Ibid.*, Chap. 5; *Twenty-Sixth Annual Report of the NACA, 1940* (Washington, D.C.: GPO, 1941), 20.

[6] Hartman, Pt. I, Chaps. 5, 6; *Twenty-Sixth Annual Report of the NACA, 1940*, 20.

[7] Hartman, Pt. I, Chaps. 5, 8; George W. Gray, *Frontiers of Flight* (New York: Alfred A. Knopf, 1948), 43-50. See Table 6-11 for a list of Ames wind tunnels.

[8] Hartman, Pt. III, Chap. 2.

[9] NASA Hq. Project Approval Documents 00-84-800-811 and 00-87-800-833, for Pioneer and Biosatellite projects, respectively.

After 1958, Ames extended earlier pioneering research in the field of variable stability aircraft, and developed ground-based simulators into highly sophisticated devices for obtaining design information on critical flight regimes encountered by V/STOL, supersonic, and hypersonic aircraft and by spacecraft. Ames research results contributed to the design and development of the XC-142 tilt-wing and the XV-5A fan-in-wing V/STOL aircraft. Through the years, Ames contributed to improvement of performance, stability, and control of most military and civil aircraft, both conventional and V/STOL.[10]

The concept of using blunt, high-drag bodies, developed by H. Julian Allen in 1952, provided a solution to problems caused by the severe aerodynamic heating of atmosphere entry at high speed. Several years later, Ames researchers devised conical spacecraft shapes to ensure the minimum total aerodynamic heating for all atmosphere-entry speeds of interest. In addition, Ames contributed to the basic understanding of ablative heat shields and to development of improved heat-shield materials. Studies of manual control and guidance of spacecraft during atmosphere entry defined optimum flight trajectories for spacecraft with a wide range of lift-drag ratios.[11]

Ames led in developing facilities for simulating high-speed atmosphere entry–using models shot from light-gas guns into high-speed jets flowing in the opposite direction or using stationary models in air or other gases heated by gas-heated pebble beds, by rapid compression, or by electric arcs. Arc-jet development, which began at Ames in 1956 and increased in intensity 1960-1962, was a major contribution to aerothermodynamic research.[12]

In studies from 1957 on, the use of lifting bodies to develop adequate aerodynamic characteristics including lift-to-drag ratios required for manned entry into planetary atmospheres, maneuvering to desired landing sites, and landing was hypothesized and experimentally verified.

Other significant Ames research achievements included improved techniques for gravity-gradient stabilization of spacecraft and for midcourse navigation of manned spacecraft, evidence for lunar origin of tektites and identification of minerals in meteorites, information on the depth of granular material on the lunar surface, measurements of the flow of solar wind around the earth, and synthesis of nucleotides.

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[10] Gray, 130-154, *passim*, and 324 ff.

[11] H. Julian Allen and A. J. Eggers, Jr., Technical Report 1381 in *Forty-Fourth Annual Report of the NACA, 1958* (Washington, D.C.: GPO, 1959), 1125-38 (superseding first unclassified publication of blunt-body discoveries, NACA Technical Note 4047, 1957). See also NASA R-236 (May 1966) for a more recent work on optimum shapes for higher atmosphere-entry speeds. For a list of Ames publications on ablative heat shields, see "Ames Ablation Bibliography" (April 18, 1966); for a summary, see Bradford H. Wick, "Ablation Characteristics and Their Evaluation by Means of Arc Jets and Arc Radiation Sources," Seventh International Aeronautical Congress, Paris, June 11-20, 1965.

[12] Hartman, Pt. III, Chap 3.

Mission

Ames Research Center's mission was assigned as research responsibility in the physical and life sciences, flight-project management responsibility for Pioneer and Biosatellite projects, and operational responsibility for the NASA Convair 990 aircraft and other research facilities:

(1) Conducting studies in atmosphere entry and environmental physics, including basic studies of the physics of high-temperature gases; stability, control, and performance of a wide range of spacecraft configurations; and spacecraft materials and structures;

(2) Conducting studies in guidance and control systems;

(3) Conducting aeronautical research directed at fundamental studies in aerodynamics, propulsion, and operating problems of subsonic, supersonic, V/STOL, and hypersonic aircraft;

(4) Conducting studies in solar physics, planetary environments, and geophysics;

(5) Conducting basic research in environmental biology, exobiology, and biotechnology, including long-term advanced life support systems.[13]

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[13] NASA, *Budget Estimates,* FY 1969, I, AO 19-20.

Table 6–11. Technical Facilities: Wind Tunnels
(with costs in thousands)

Facility Name	Year Built	Test Section Size in Meters (and feet)	Mach No. Range	Reynolds No. Range	Init. Cost	Accum. Cost	Research Supported
7- by 10-foot wind tunnel No. 1	1941	2.1H x 3.0W x 4.9L (7H x 10W x 16L)	CV up to 402.3 km per hr (250 mph)	2.3×10^6 max.	$ 438[a]	$ 1 318[a]	Low-speed aerodynamics (on loan to U.S. Army)
7- by 10-foot wind tunnel No. 2	1941	"	"	"	NA[b]	NA[b]	Low-speed aircraft and V/STOL configurations (on standby basis)
40- by 80-foot wind tunnel	1944	12.2H x 24.4W x 24.4L (40H x 80W x 80L)	0.0 to 370 km per hr CV (0.0 to 230 mph CV)	0.0 to 2.1×10^6	7 139	8 886	Low-speed aerodynamics research on V/STOL aircraft and hovercraft
12-foot pressure wind tunnel	1946	3.5H x 3.5W x 5.5L (11.3H x 11.3W x 18L)	0.0 to 0.98 CV	0.0 to 9×10^6	3 489	5 094	Aerodynamics of aircraft and spacecraft at subsonic speeds in airstreams of unusually low turbulence
1- by 3-foot supersonic wind tunnel	1946	0.4 to 1.5H x 0.3W x 1.7L (1.25 to 2.8H x 1W x 5.5L)	0.4 to 0.9 and 1.4 to 6.0	0.5×10^6 to 12×10^6	1 228	4 118	Aircraft aerodynamics at supersonic and hypersonic ranges
6- by 6-foot supersonic wind tunnel	1948	1.8H x 1.8W x 4.4L (6H x 6W x 14.4L)	0.25 and 0.6 to 2.2 CV	1×10^6 to 5×10^6	3 802	6 380	Space vehicle aerodynamics, launch vehicle structural loads, aircraft aerodynamics at hypersonic and supersonic ranges
42-inch shock tunnel (formerly 1-foot shock tunnel)	1949	Hexagonal, 1.1 dia x 1.8 L (3.5 dia x 6L)	4.5 to 14.0	1×10^4 to 1×10^6	327	1 468	Spacecraft aerodynamics, heat transfer studies on reentry
Pressurized ballistic range	1949	0.5 to 1.5 dia x 61L (1.5 to 5 dia x 203L)	3352.8 m per sec (11 000 fps) model speed	300×10^6	NA[c]	NA[c]	Supersonic and hypersonic aerodynamics
2- by 2-foot transonic wind tunnel	1951	0.6H x 0.6W x 1.5L (2H x 2W x 5L)	0.6 to 1.4 CV	1×10^6 to 8.7×10^6	447	1 431	Space vehicle aerodynamics, aircraft aerodynamics, structural dynamics
14-foot transonic wind tunnel	1955	4.2H x 4.3W upstream to 4.3W downstream x 10.3L (13.5H x 13.7W upstream to 13.9W downstream x 33.75L)	0.6 to 1.2 CV	2.8×10^6 to 4.2×10^6	1 881	11 427[d]	Aircraft aerodynamics, structural loads for launch vehicle structures
11-foot transonic wind tunnel (unitary)	1955	3.4H x 3.4W x 6.7L (11H x 11W x 22L)	0.7 to 1.4 CV	1.7×10^6 to 9.4×10^6	24 848[e]	32 253[e]	Subsonic and transonic aerodynamics

Table 6–11. Technical Facilities: Wind Tunnels (Continued)
(with costs in thousands)

Facility Name	Year Built	Test Section Size in Meters (and feet)	Mach No. Range	Reynolds No. Range	Init. Cost	Accum. Cost	Research Supported
8- by 7-foot supersonic wind tunnel	1955	2.4H x 2.1W x 4.9L (8H x 7W x 16L)	2.45 to 3.5 CV	1×10^6 to 5×10^6	NA[f]	NA[f]	Aircraft aerodynamics, subsonic and supersonic
9- by 7-foot supersonic	1955	2.1H x 2.7W x 5.5L (7H x 9W x 18L)	1.55 to 2.5 CV	1.5×10^6 to 6.5×10^6	NA[f]	NA[f]	Supersonic aerodynamics
Hypervelocity ballistic range	1955[g]	–	–	–	1 555[h]	3 272[h]	Resistance of space structures to meteoroid impact; 4 light-gas-gun and flight-range combinations
Hypersonic helium tunnel	1960	0.5 dia (1.66)	8, 15, 20, 26	7×10^6 to 13×10^6	1 776	2 674	Heat, mass, and momentum transfer, spacecraft, aerothermodynamics
3.5-foot hypersonic wind tunnel	1960	1.1 dia (3.5)	5 to 15, 1 to 4 min, 35-min recycle	1×10^6 to 6.9×10^6	12 630	13 332	Aerodynamics, heat transfer, and ablation
Gas dynamics lab	1962	Model sizes up to 0.2 (0.5) dia	Variable up to 17	–	4 778	5 150	Materials in heat-shield applications; vehicle aerodynamics in planetary atmospheres
Hypervelocity free flight facility (pilot model)	1962	0.6 dia x 12.2L (2 dia x 40L)	8 534.4 m per sec (28 000 fps) model speed	80×10^6	374	384	High-temperature gaseous radiation and radiative heat transfer in earth's and planetary atmospheres
Hypervelocity free flight facility	1964	3 gun-range combinations: (a) 1.1 dia x 22.9L (3.5 dia x 75L) (b) 0.9 dia x 17.1L (3 dia x 56L) (c) 1.1 dia x 5.5L (3.5 dia x 18L)	9 144 m per sec (30 000 fps) model speed	80×10^6	5 230	5 412	Gas dynamic problems of hypervelocity flight, particularly atmosphere entry problems, with models flying 9509.8 m per sec (31 200 fps) into a 3901.4-m-per-sec (12 800-fps) air-stream for a total relative speed of 13 411.2 m per sec (44 000 fps)
Mach 50 helium	1964	0.6 m dia (2 dia)	30, 35, 40, 50	0.18×10^6 to 0.67×10^6	1 530	2 132	Hypersonic aerodynamics

[a] Including 7- by 10-foot wind tunnel No. 2

[b] Included in costs of tunnel No. 1.

[c] Costs included in Bldg. 208.

[d] Including costs of conversion from 16-foot high-speed wind tunnel.

[e] Including all wind tunnels in unitary complex.

[f] In unitary complex.

[g] Fourth launcher (impact) built in 1961-1962.

[h] Costs include Bldg. 224, atmosphere entry simulator.

CV = Continuously variable.
NA = Not available.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), I, Sect. 1.

Table 6-12. Technical Facilities Other Than Wind Tunnels

Functional Name	Year Built	Init. Cost (thousands)	Accum. Cost	Research Supported
Flight Simulation Laboratory	1940	$248	$4386	Piloting problems and control systems for all kinds of aircraft, launch vehicles, and spacecraft
Space Technology Facility	1955	1154[a]	1995[a]	Geochemical studies of meteorites, cratering studies, spaceborne magnetic-field and plasma analysis and experiments, and basic fluid-physics research
Physical Sciences Research Laboratory	1961	879	959	Fundamentals of gas dynamics under extreme conditions
Bioscience Laboratory	1964	952	1009	Experimental pathology; housing for experimental animals
Life Sciences Research Facility	1965	4204	4629	Biotechnology, environmental biology, and exobiology
Space Environment Research Facility	1965	2124	3464	Effects of space environment on spacecraft materials
Structural Dynamics Laboratory	1966	NA[b]	NA[b]	Response of aircraft, launch vehicle, and spacecraft structures to impact, vibration, and thermal loads
Flight and Guidance Simulation Laboratory	1966	NA[b]	NA[b]	Navigation, guidance, and control systems for aircraft, launch vehicles, and spacecraft

[a] Including costs of Bldg. 204.
[b] Building costs estimates pending.

NA = Not available.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), I, Sect. 1.

Table 6-13. Property
(as of June 30; money amounts in thousands)

Category	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
Land in hectares (and acres)										
Owned	15.9[a] (39.4)	15.9 (39.4)	15.9 (39.4)	46.6[b] (115.0)	46.6 (115.0)	46.6 (115.0)	91.4[c] (225.7)	91.4 (225.7)	147.9[d] (365.5)	147.9 (365.5)
Leased	0	0	0	0	0	0	0	0	0	0.5 (1.1)
Buildings										
Number of major buildings owned[e]	27	27	30	33	34	36	38	41	43	55
Area of buildings owned, thousands of sq m (and sq ft)[f]										
Gross floor area[g]	85.1 (916)	85.1 (916)	94.5 (1017)	101.9 (1097)	102.8 (1106)	111.7 (1202)	116.4 (1253)	138.5 (1491)	160.4 (1727)	163.3 (1758)
Including adjacent structures	129.7 (1396)	129.7 (1396)	142.0 (1528)	151.2 (1628)	152.3 (1639)	161.2 (1735)	166.6 (1792)	188.8 (2032)	210.7 (2268)	211.4 (2276)
Areas previously reported[h]	0	0	0	130.7 (1407)	142.5 (1534)	153.0 (1647)	169.6 (1826)	178.0 (1916)	160.4 (1726)	163.3 (1758)
Area of buildings leased, thousands of sq m (and sq ft)	0	0	0	0	1.2 (13)	1.2 (13)	1.2 (13)	0	0	1.5 (16)
Value										
Land	$ 20	$ 20	$ 20	$ 663	$ 663	$ 773[j]	$ 773	$ 773	$ 2 373	$ 2 372
Buildings	80 390	82 658	96 926	107 156	110 639[k]	120 259[l]	129 021	133 769	159 406	161 816
Other structures and facilities[i]	–	–	–	–	2 232[m]	2 268[n]	2 112[o]	2 112	2 346	2 383
Real property	$80 410	$82 678	$96 946	$107 819	$113 534	$123 190	$131 906	$136 654	$164 125	$166 571
Capitalized equipment	$12 608	$13 335	$13 368	$ 15 120[p]	$ 17 806[q]	$ 22 955	$ 28 119	$ 34 674	$ 41 812	$ 53 670

[a] Two tracts 11.3 and 4.7 hectares (28.0 and 11.4 acres), acquired by direct purchases Dec. 15, 1939; 30.6 hectares (75.6 acres) of U.S. Navy land were available to Ames through "license-to-use" permits.

[b] 30.6 hectares (75.6 acres) held under use permit from U.S. Navy transferred to NASA ownership. Acreage included original 25.1 hectares (62.0 acres) granted to NACA by U.S. War Department in December 1939, 5.8 acres granted Ames by use permit from the U.S. Navy April 1945, and 3.1 hectares (7.8 acres) obtained on U.S. Navy use permit later.

[c] 44.8 hectares (110.7 acres) was obtained in May 1964 on a "license-to-use" basis from U.S. Navy and transferred to NASA in 1965.

[d] 56.6 hectares (139.8 acres) acquired May 23, 1967, through trade for surplus U.S. Navy land in San Diego.

[e] Number of major structures or complexes assigned an Ames "N" classification number (excluding the Electrical Substation, N-225). Single construction projects were usually assigned one "N" number, and costs were accumulated as one project, even though several buildings or structures were involved. Components of these major buildings are included in totals used in Tables 2-1 and 2-7 in Chapter Two.

[f] Adjacent structures include vertical projection on horizontal plane of wind tunnels, water cooling towers, docks, outside passageways, vacuum spheres, water towers, etc.

Table 6–14. Value of Real Property Components as Percentage of Total
(as of June 30; total property value in thousands)

Component	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
Land	*	*	*	0.6	0.6	0.5	0.5	0.6	1.5	1.5
Buildings	99.9	99.9	99.9	99.4	97.5	97.6	97.8	97.8	97.1	97.1
Other structures and facilities[a]	NA	NA	NA	NA	1.9	1.9	1.7	1.6	1.4	1.4
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total ARC–real property value	$80 410	$82 678	$96 946	$107 819	$113 534	$123 190	$131 906	$136 654	$164 125	$166 571

[a] Other structures and facilities were included with buildings during FY 1959 through FY 1962.

* = Less than 0.1%

NA = Not available.

Source: Derived from Tables 2-10 through 2-13 in Chapter Two.

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[g] Definition of floor area was refined in 1967; increase of about 93 sq m (1000 sq feet) in gross floor area over FY 1967 figure previously reported was because of inclusion of a small building (N–205) which was once considered inconsequential.

[h] Previously reported figures are used in Tables 2–1 and 2–8 in Chapter Two; decrease in area from 1966 to 1967 was due to a change in definition to "floor area" for Maintenance, Repair, and Operation of Facilities Report. By FY 1968 the reported figure was the same as "gross floor area."

[i] Included in figures for buildings from FY 1959 through FY 1962.

[j] Adjusted figure: $1 258 000 appeared in end of fiscal year reports.

[k] Adjusted figure: $110 796 000 appeared in end of fiscal year reports.

[l] Adjusted figure: $120 417 000 appeared in end of fiscal year reports.

[m] Adjusted figure: $1 887 000 appeared in end of fiscal year reports.

[n] Adjusted figure: $1 923 000 appeared in end of fiscal year reports.

[o] Adjusted figure: $1 925 000 appeared in end of fiscal year reports.

[p] Adjusted figure: $15 500 000 appeared in end of fiscal year reports.

[q] Adjusted figure: $18 584 000 appeared in end of fiscal year reports.

NA = Not available.

Sources: NASA, Office of Facilities; Ames Master Plan (April 1966). Supplementary information was provided by George H. Holdaway and Merrill H. Mead.

Table 6-15. Personnel

Employee Category	1958		1959		1960		1961		1962		1963	
	9/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31
Requested for FY ending	–		–		1509		1440		1437		2051	
Total, paid employees	1413	1427	1464	1429	1421	1418	1462	1529	1658	1825	2116	2166
Permanent	1386	1406	1439	1413	1404	1397	1429	1502	1631	1788	1964	2110
Temporary	27	21	25	16	17	21	33	27	27	37	152	56
Code group (permanent only)												
200[a]	78	80	83	86	82	79	79	33	39	42	48	48
700[b]	357	355	370	360	374	362	392	473	543	586	663	725
900	0	0	0	0	0	0	0	0	0	0	10	16
Subtotal	435	435	453	446	456	441	471	506	582	628	721	789
600[c]	0	0	0	0	0	40	40	43	50	61	83	87
500	175	181	188	181	173	136	131	142	158	188	214	261
300	159	162	163	151	147	149	157	167	179	191	208	215
100	617	628	635	635	628	631	630	644	662	720	738	758
Subtotal	951	971	986	967	948	956	958	996	1049	1160	1243	1321
Excepted: on duty	0	15	21	21	21	21	22	24	26	25	28	28
Accessions: permanent	119	42	115	65	85	63	71	142	178	251	250	223
Accessions: temporary	48	4	9	1	7	22	28	34	26	29	158	42
Military detailees	21	19	14	19	16	16	16	19	16	12	10	14

Table 6-15. Personnel (Continued)

Employee Category	1964		1965		1966		1967		1968
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Requested for FY ending	2309		2176		2185		2191		2171
Total, paid employees	2204	2215	2270	2236	2310	2232	2264	2171	2197
Permanent	2152	2136	2175	2155	2191	2189	2173	2164	2084
Temporary	52	79	95	81	119	43	91	7	113
Code group (permanent only)									
200[a]	34	30	32	31	28	29	31	31	28
700[b]	757	768	776	782	815	837	842	859	847
900	23	16	17	14	16	15	14	13	10
Subtotal	814	814	825	827	859	881	887	903	885
600[c]	109	113	119	125	127	140	140	143	144
500	256	251	256	261	298	293	281	276	255
300	198	199	209	199	185	181	180	202	213
100	775	759	766	743	722	694	685	640	587
Subtotal	1338	1322	1350	1328	1332	1308	1286	1261	1199
Excepted: on duty	76	25	19	19	20	21	20	21	21
Accessions: permanent	107	93	115	105	128	104	93	–	–
Accessions: temporary	60	114	103	124	143	39	98	–	–
Military detailees	13	11	11	10	9	10	9	10	13

[a] Beginning June 30, 1961, the data reflect conversion of some professionals from the 200 Code group (engineers) to the 700 Code group (aerospace technologists). For key to Code group numbers and definition of terms, see Chapter Three.

[b] Data before June 30, 1961, are for "aeronautical research scientists." Beginning June 30, 1961, the data reflect conversion of these personnel members to the 700 Code group (aerospace technologists).

[c] Before Dec. 31, 1960, the data reflect inclusion of Code group 600 personnel in the 500 Code group.

NA = Not available.

Source: NASA, Personnel Division. Data through Dec. 31, 1966, from NASA Quarterly Personnel Statistical Report; data after Dec. 31, 1966, from NASA Personnel Management Information System and the NASA Supplement to SF 113 A, "Monthly Report of Federal Civilian Employment Short Form."

Table 6-16. Distribution of Permanent Personnel Positions by Fiscal Year and Budget Activity[a]

Program	1959[b]	1960[b]	1961	1962	1963	1964	1965	1966	1967	1968
Manned space flight			16	0	0	19	5	10	7	11
(% of total)	(0.0)	(0.0)	(1.1)	(0.0)	(0.0)	(0.8)	(0.2)	(0.4)	(0.3)	(0.5)
Space applications			30	0	0	0	0	4	9	1
(% of total)	(0.0)	(2.0)	(2.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.2)	(0.4)	(0.05)
Unmanned investigations in space			220	32	336	360	395	395	392	340
(% of total)	(2.0)	(8.0)	(14.8)	(1.9)	(16.9)	(16.4)	(17.5)	(17.8)	(18.0)	(16.3)
Space research and technology			795	1244	1012	863	839	933	916	939
(% of total)	(4.0)	(15.0)	(53.5)	(74.5)	(51.0)	(39.2)	(38.0)	(42.0)	(42.2)	(45.1)
Aircraft technology[c]			426	393	319	292	351	406	399	353
(% of total)	(94.0)	(75.0)	(28.6)	(23.6)	(16.1)	(13.3)	(15.9)	(18.3)	(18.4)	(16.9)
Supporting activities[d]			0	0	318	667	620	475	450	439
(% of total)	(0.0)	(0.0)	(0.0)	(0.0)	(16.0)	(30.3)	(28.0)	(21.3)	(20.7)	(21.1)
Total ARC			1487	1669	1985	2201	2210	2223	2173	2083

[a] Based on number of actual positions reported in annual NASA Budget Estimates. FY 1961 actual figure was reported in NASA, *Budget Estimates, FY 1963*; FY 1962 actual figure was reported in NASA *Budget Estimates, FY 1964*, etc.

[b] Actual positions data are not available for FY 1959 and FY 1960. Percentages in these two columns are based on distribution used by NASA Office of Programming, Budget Operations Division, in preparing *History of Budget Plans, Actual Obligations, and Actual Expenditures for Fiscal Years 1959 Through 1963* (Washington, D.C.: NASA, 1965), Sect. 8.

[c] FY 1961 figure represents "aircraft and missile technology."

[d] FY 1963 and later figures include tracking and data acquisition, technology utilization, and general-support positions. Until FY 1963 general-support positions were reported with the 5 other budget activities.

Source: NASA, *Budget Estimates*, FY 1963–FY 1969; NASA, Budget Operations Division.

Table 6-17. Funding by Fiscal Year
(program plan as of May 31, 1968, in millions)

Appropriation Title	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total
Research and development	0	$ 3.60	$ 4.30	$ 1.50	$16.80	$40.30	$54.20	$64.00	$65.60	$ 66.60	$316.90
Construction of facilities[a]	$ 3.75	6.20	0.54	6.30	14.29	11.37	5.67	2.75	0	3.17	54.04
Administrative operations[b]	16.30	17.76	19.89	22.92	25.57	29.87	31.82	33.23	33.81	33.76	264.93
Total	$20.05	$27.56	$24.73	$30.72	$56.66	$81.54	$91.69	$99.98	$99.41	$103.53	$635.87

[a] Does not include facilities planning and design.

[b] FY 1959–1962 appropriations were for salaries and expenses; FY 1963 appropriation was for research, development, and operation.

Source: NASA, Office of Programming, Budget Operations Division, *History of Budget Plans, Actual Obligations, and Actual Expenditures for Fiscal Years 1959 Through 1963* (Washington, D.C.: NASA, February 1965); NASA, Budget Operations Division, "Status of Approved Programs," FY 1959–FY 1968, May 1968.

Table 6–18. Actual Obligations for Construction of Facilities by Fiscal Year and Program Year
(in millions)

Program Year	Program Plan[a]	FY 1959	FY 1960	FY 1961	FY 1962	FY 1963	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	Total
1959	$ 3.7	$1.7	$1.4	$0.5	$0.1	$ *	0	-*	0	0	0	$ 3.7
1960	6.2		1.0	2.9	1.7	*	$ 0.3	$ 0.2	*	0	0	6.2
1961	0.5			0.2	0.3	*	0	*	0	0	0	0.5
1962	6.5				1.0	4.5	0.5	0.3	$0.3	-*	-*	6.5
1963	14.6					2.4	6.9	2.9	1.2	$0.7	$0.5	14.5
1964	11.6						4.2	5.3	1.7	0.2	*	11.5
1965	5.8							4.9	0.5	0.2	0.1	5.8
1966	2.8								2.1	0.5	0.1	2.8
1967	0.3									0	0.2	0.2
1968	3.2										0	0
Total	$55.2	$1.7	$2.4	$3.6	$3.1	$7.0	$11.9	$13.6	$5.8	$1.6	$0.9	$51.7

[a] As of June 30, 1968; includes facilities planning and design.

* = Less than $100 000. Because of rounding, columns and rows may not add to totals.

Source: NASA, Budget Operations Division, "Status of Approved Programs, Construction of Facilities," FY 1959–FY 1968, June 1968; NASA, Financial Management Division, "Summary Financial Status of Programs," June 30, 1968.

Table 6–19. Total Procurement Activity by Fiscal Year
(money amounts in millions)

	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total
Net value of contract awards	$7.7	$11.0	$14.4	$28.0	$47.9	$80.9	$77.3	$86.3	$78.5	$432.0
Percentage of NASA total	2%	2%	1%	1%	1%	2%	2%	1.9%	1.9%	1.5%

Source: NASA, Procurement and Supply Division, *NASA Procurement: October 1, 1958 to June 30, 1960* (Washington, D.C.: NASA, September 1960); NASA, *Annual Procurement Report*, Fiscal Years 1961–1968 (Washington, D.C.: NASA, 1962–1968).

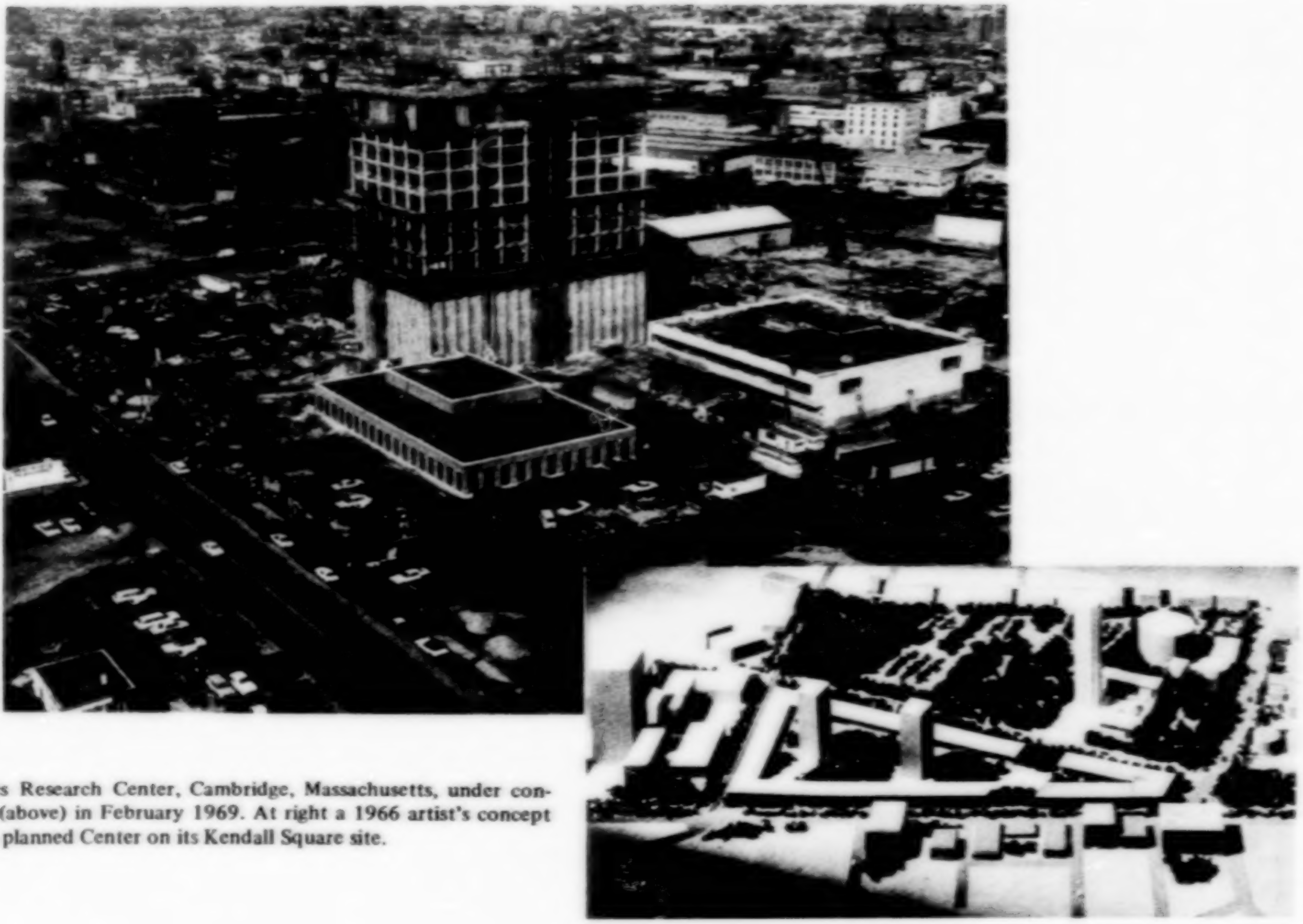
Table 6-20. Awards to Personnel Granted under Section 306 of the Space Act of 1958[a]

Year	Inventor	Contribution	Amount
1964	Adrien E. Anderson Woodrow L. Cook James C. Daugherty J. Lloyd Jones, Jr. David G. Koenig	Commercial air transport	$1000
	Alfred J. Eggers, Jr. Clarence A. Syvertson George G. Edwards George C. Kenyon	Flight craft	1000
1965	Howard A. Stine Charles E. Shepard Velvin R. Watson	Electric arc apparatus	2500

[a] For complete listing of awards under this Act, see Appendix A, Sect. 1.B.

Source: NASA, Inventions and Contributions Board.

ELECTRONICS RESEARCH CENTER



Electronics Research Center, Cambridge, Massachusetts, under construction (above) in February 1969. At right a 1966 artist's concept shows the planned Center on its Kendall Square site.

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ELECTRONICS RESEARCH CENTER (ERC)

Location: Cambridge, Middlesex County, Massachusetts.

Land: 3.6 hectares (8.8 acres) NASA-owned; as of June 30, 1968, 1.24 hectares (3.06 acres) planned for acquisition during FY 1969; 5.0 additional hectares (12.4 acres) ultimately would be acquired.

Director: James C. Elms (Oct. 1, 1966-).
Winston E. Kock (Sept. 1, 1964-Oct. 1, 1966).

Deputy Director:
Albert J. Kelly (Sept. 1, 1964-June 1, 1967).

History

During the first few years after NASA's establishment in 1958, electronics research and development was diffused throughout the agency, conducted as part of the development of booster, spacecraft, or ground support systems. NASA had not fallen heir to electronics research competence to the degree that it had inherited capabilities in other disciplines from the NACA field installations and through the transfer of personnel and projects from the Department of Defense. A limited competence related to specific mission requirements had developed at various NASA Centers, but NASA depended heavily on research conducted in industry and the universities.[1]

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[1] Letter, NASA Administrator James E. Webb to Chairman George P. Miller, House Committee on Science and Astronautics, March 21, 1963, reprinted in U.S. Congress, House, Committee on Science and Astronautics, Subcommittee on Applications and Tracking and Data Acquisition, *1964 NASA Authorization, Hearings,* Pt. 4, 88th Cong., 1st sess., March 12-14, 19, 20, 26, April 2-3, 9, 10, 30, May 2, 9, June 6, 1963 (Washington, D.C.: GPO, 1963), 3012-3015.

The ERC history section was prepared for the *Data Book* by Edward T. Martin, Electronics Research Center, with supplementary information provided by Richard D. Dowling, NASA History Office.

On November 1, 1961, recognizing the importance of electronics to future space exploration and the need for improving its in-house capability in the field, NASA gave electronics technology the same organizational status as propulsion research and aeronautical and space vehicle studies. On that date, in a major NASA reorganization, a Directorate of Electronics and Control was established in the Office of Advanced Research and Technology.[2] In the March 2, 1962, guidelines from the Associate Administrator for preparation of the FY 1964 NASA budget, OART was directed to include in the budget "a plan to strengthen NASA's capability in the electronics and guidance and control field to support current and long-range programs. . . ."[3]

Establishment of a new research center specializing in electronics was recommended in late September 1962 by the Director of Electronics and Control, and in early October he recommended the Greater Boston area as the best location for the new installation.[4] The area had an "overall university-industrial strength and capability in electronics and guidance research," and because of this concentration of current research, Boston was expected to provide "a compatible, stimulating environment for regenerative growth of NASA electronic capabilities."[5]

In mid-October 1962 in the process of presenting the FY 1964 NASA budget for President Kennedy's approval, the NASA Administrator "initially discussed the proposed Electronics Research Center and the suggested Boston location."[6] During detailed discussions of the entire NASA budget, the Administrator reviewed the proposal with the Bureau of the Budget in the first half of December 1962.[7]

President Kennedy sent the FY 1964 budget to Congress January 17, 1963, including $5 million in the construction of facilities request for land acquisition and design and engineering services for an Electronics Research Center in the Greater Boston area.[8] On February 6, 1963, NASA established an Electronics Research Task Group in Boston as a temporary field annex to the Office of Advanced Research and Technology, to "conduct that planning necessary to prepare NASA for prompt action" when Congress approved the proposed Center.[9] After extensive hearings, in which both House and Senate Committees questioned closely the need for and proposed location of the new Center, $3.9 million was authorized and appropriated for land acquisition and preliminary design in FY 1964.[10]

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[2] NASA, Office of Advanced Research and Technology, Electronics and Control Directorate, "NASA Electronics Research Center: Staff Report," January 1963, 1-2; U.S. Congress, Senate, Committee on Aeronautical and Space Sciences, *NASA Authorization for Fiscal Year 1964, Hearings*, Pt. 1, 88th Cong., 1st sess., April 24-30, 1963 (Washington, D.C.: GPO, 1963), 706-707.

[3] Senate, Committee. . ., *NASA Authorization for Fiscal Year 1964, Hearings*, Pt. 1, 706; NASA, "NASA Electronics Research Center: Staff Report," 5-6.

[4] Senate, Committee. . ., *NASA Authorization for Fiscal Year 1964, Hearings*, Pt. 1, 383-384.

[5] NASA, "Electronics Research Center: Staff Report," 23.

[6] Senate, Committee. . ., *NASA Authorization for Fiscal Year 1964, Hearings*, Pt. 1,

[7] *Ibid.*

[8] *Ibid.*, Pt. 2, June 12, 13, 17, 18, 1963, 935 ff.

The NASA Authorization Act, 1964, stipulated that no funds might be expended until the NASA Administrator submitted a full report on the research Center. A fact-finding committee was established to study the geographic location, and other committees were formed to examine the need and the nature of the proposed Center. A complete report was transmitted to Congress January 31, 1964.[11]

On July 11, 1964, President Johnson signed the NASA Authorization Act, 1965, which included $10 million in construction funds for the new Center.[12] A site evaluation committee, convened in March 1964, worked through July studying 160 possible locations.[13] On August 19, 1964, the NASA Administrator accepted the offer of the City of Cambridge, Massachusetts, of 11.7 hectares (29 acres) of land in Kendall Square.[14]

The Electronics Research Center was established officially September 1, 1964.[15] NASA's North Eastern Office (established August 14, 1962) and the Electronics Research Task Group were combined, and the personnel of both (totaling 80) were placed under the ERC Director.[16] In November 1964, Electronics Research Center moved from the building occupied by North Eastern Office at 30 Memorial Drive, Cambridge, into leased space at Technology Square in Cambridge.[17] Recruiting of scientists, technicians, and support personnel began immediately, and by June 30, 1965, the Center had 238 permanent, full-time employees. Its permanent staff numbered 794 on June 30, 1968.[18] A broad program was undertaken in five areas of electronics research—electronic components, guidance and control, systems, instrumentation and data processing, and electromagnetics.[19]

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[9] Memorandum, NASA Associate Administrator Robert C. Seamans, Jr., to R. L. Bisplinghoff, Director, Office of Advanced Research and Technology, Feb. 6, 1963, Subject: Establishment of an Electronics Research Task Group; NASA, Office of Advanced Research and Technology, Electronics Research Task Group, "Electronics Research Center: Requirements, Operations, Implementation Plans," July 1963.

[10] NASA Authorization Act, 1964, P.L. 88-113, 77 Stat. 141, Sept. 6, 1963; Independent Offices Appropriation Act, 1964, P.L. 88-215, 77 Stat. 425, Dec. 19, 1963.

[11] NASA Release 63-233; NASA Announcement 63-255, Nov. 14, 1963; NASA, *Report on Electronics Research Center*, prepared for U.S. Congress, Senate, Committee on Aeronautical and Space Sciences (Washington, D.C.: GPO, Jan. 31, 1964).

[12] NASA Authorization Act, 1965, P.L. 88-369, 78 Stat. 310, July 11, 1964.

[13] U.S. Congress, Senate, Committee on Aeronautical and Space Sciences, *NASA Authorization for Fiscal Year 1966, Hearings*, Pt. 2, 89th Cong., 1st sess., March 22-30, 1965 (Washington, D.C.: GPO, 1965), 760.

[14] Letter, NASA Administrator James E. Webb to Cambridge Mayor Edward Crane, Aug. 19, 1964; NASA Release 64-208.

[15] NASA General Management Instruction No. 2-2-18, Sept. 1, 1964; NASA Releases 64-172, 64-199, and 64-201.

[16] ERC Release 64-4; NASA Release 64-219.

[17] Senate, Committee. . ., *NASA Authorization for Fiscal Year 1966*, Pt. 2, 760; ERC Release (unnumbered), Nov. 13, 1964.

[18] ERC Personnel Files; NASA Office of Administration, Personnel Division.

The first research and development procurement request to industry was issued December 4, 1964, for a study to identify guidance and navigation research efforts.[20] The first research grant was awarded in December 1964 to the University of Pennsylvania for a $40 000 survey of the state of the art in microwave research.[21]

In-house research began in such varied fields as holography, laser gyroscopes, thin film microelectronics, and aircraft collision avoidance systems. Electronics Research Center was identified as the lead Center to begin the development, in 1967, of a detailed plan to provide the necessary technology for an integrated avionics system for a second-generation supersonic transport during the 1972-1975 time span.[22]

Construction plans for the permanent site were begun December 8, 1964, with the award of a master planning contract to the joint venture firm of Edward Durell Stone, New York City; Giffels & Rossetti, Detroit; and Charles A. Maguire Associates, Boston-Providence.[23] The New England Division of the U.S. Army Corps of Engineers was designated in March 1963 as design and construction agent.[24] Groundbreaking for the first phase of construction was held November 2, 1966.[25]

Mission

The mission of Electronics Research Center was research and development to improve performance and reliability of space and aeronautical electronic systems and components:

(1) Organizing, managing, and conducting basic and applied aerospace electronics research to investigate concepts and techniques leading to space and aeronautical electronic equipment with reliability and performance characteristics far beyond those of 1968;

(2) Providing a focal point for national aerospace electronics research, coordinating nationwide research efforts and sponsoring electronics research conducted by industry, universities, and private institutions.

Research focused on (a) aerospace electronics materials and components; (b) guidance and navigation of space vehicles, aircraft, and supporting ground-based equipment; (c) space vehicle and aircraft control, stabilization, and information systems; (d) electronic system simulation, analysis, evaluation, and integration in the fields of guidance, control, navigation, tracking, communication, and instrumentation; (e) electronic power conditioning and distribution; (f) bioelectronics; (g) space and ground-based computers, computing systems, and instrumentation technology; (h) solid state physics, microwave propagation, microwave communications, and transmitting and receiving phenomena; (i) optical communications; and (j) astrophysical measurements.[26]

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[19] Senate, Committee. . ., *NASA Authorization for Fiscal Year 1966,* Pt. 2, 761, Fig. 233; NASA General Management Instruction 2-2-18, Attachment A.

[20] ERC News Release (unnumbered), Dec. 4, 1964.

[21] ERC News Release (unnumbered), Dec. 18, 1964.

[22] U.S. Congress, House, Committee on Science and Astronautics, Subcommittee on Advanced Research and Technology, *1968 NASA Authorization, Hearings,* Pt. 4, 90th Cong., 1st sess., March 14-22, April 4-20, 1967 (Washington, D.C.: GPO, 1967), 287.

[23] NASA Release 64-307.

[24] Department of Defense News Release 366-63.

[25] ERC Construction Projects Office; Daily Log (Corps of Engineers Notice to Proceed, to Contractor, Oct. 25, 1966).

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[26] NASA, *Budget Estimates*, FY 1969, IV, AO 2-57, 2-58.

Table 6-21. Property
(as of June 30; money amounts in thousands)[a]

Category	1965	1966	1967	1968
Land in hectares (and acres)				
Owned	0	2.4 (6)	2.6 (6.3)	3.6 (8.8)
Leased	0	0	0	0
Buildings				
Number owned	0	0	0	0
Area owned, thousands of sq m (and sq ft)	0	0	0	0
Area leased, thousands of sq m[b] (and sq ft)	9.0 (97.0)	12.1 (130.3)	20.3 (218.2)	23.0 (247.5)
Value				
Land	0	$739	$769	$1 099
Buildings	0	0	0	1 671
Other structures and facilities	0	0	0	9
Real property	0	$739	$769	$2 779
Capitalized equipment	$100	$1808	$6961	$13 227

[a] For definition of terms, see Introduction to Chapter Two.

[b] GSA-leased; not included in NASA total in Table 2-9 in Chapter Two.

Source: NASA, Office of Facilities.

Table 6–22. Personnel

	1963		1964		1965		1966		1967		1968
	6/30[a]	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Requested for FY ending			250		250		550		1000		1041
Total, paid employees	25	30	33	117	250	340	555	619	791	785	950
Permanent	24	29	32	117	238	331	470	570	700	744	794
Temporary	1	1	1	0	12	9	85	49	91	41	156
Code group (permanent only)											
200	0	0	0	3	7	7	13	15	19	17	19
700	4	5	6	41	87	131	204	253	319	356	381
900	0	0	0	0	0	0	0	0	0	0	0
Subtotal	4	5	6	44	94	138	217	268	338	373	400
600	8	9	9	24	48	66	83	90	104	113	122
500	10	12	14	45	85	113	133	161	185	182	184
300	2	3	3	4	11	13	30	42	64	66	77
100	0	0	0	0	0	1	7	9	9	10	11
Subtotal	20	24	26	73	144	193	253	302	362	371	394
Excepted: on duty	2	2	2	4	8	7	7	7	7	7	7
Accessions: permanent	2	3	3	66	124	106	151	132	169	NA	NA
Accessions: temporary	0	0	0	0	11	23	98	45	84	NA	NA
Military detailees	0	0	0	3	3	1	3	3	0	5	6

[a] Includes NASA North Eastern Office for last three months of reporting period; personnel of North Eastern Office and Electronics Research Task Group merged on Sept. 1, 1964, to form the initial personnel complement of ERC. For key to Code group numbers and definition of terms, see Chapter Three.

NA = Not available.

Source: NASA, Personnel Division. Data through Dec. 31, 1966, from NASA Quarterly Personnel Statistical Report; data after Dec. 31, 1966, from NASA Personnel Management Information System and the NASA Supplement to SF 113–A, "Monthly Report of Federal Civilian Employment Short Form."

Table 6–23. Distribution of Permanent Personnel Positions by Fiscal Year and Budget Activity[a]

Program	1964	1965	1966	1967	1968
Manned space flight	0	0	0	0	0
(% of total)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Space applications	0	0	4	13	17
(% of total)	(0.0)	(0.0)	(0.8)	(1.8)	(2.1)
Unmanned investigations in space	0	0	6	18	31
(% of total)	(0.0)	(0.0)	(1.2)	(2.6)	(3.9)
Space research and technology	8	115	256	368	434
(% of total)	(32.0)	(47.1)	(50.2)	(52.6)	(54.7)
Aircraft technology	0	0	1	2	0
(% of total)	(0.0)	(0.0)	(0.2)	(0.3)	(0.0)
Supporting activities[b]	17	129	243	299	312
(% of total)	(68.0)	(52.9)	(47.6)	(42.7)	(39.3)
Total ERC	25	244	510	700	794

[a] Based on number of actual positions reported in annual NASA Budget Estimates. FY 1964 actual figure was reported in NASA, *Budget Estimates, FY 1966*; FY 1965 actual figure was reported in NASA, *Budget Estimates, FY 1967*; etc.

[b] FY 1964 and later figures include tracking and data acquisition, technology utilization, and general-support positions.

Source: NASA, *Budget Estimates*, FY 1966–FY 1969; NASA, Budget Operations Division.

Table 6-24. Funding by Fiscal Year
(program plan as of May 31, 1968, in millions)

Appropriation Title	1964	1965	1966	1967	1968	Total
Research and development	$0.20[b]	$ 2.70	$ 8.80	$16.40	$27.00	$ 55.10
Construction of facilities[a]	3.68	10.50	5.25	7.50	0	26.93
Administrative operations	0.51[b]	3.20	6.36	12.22	15.38	37.67
Total	$4.39	$16.40	$20.41	$36.12	$42.38	$119.70

[a] Does not include facilities planning and design.
[b] NASA North Eastern Office.

Source: NASA, Office of Programming, Budget Operations Division, *History of Budget Plans, Actual Obligations and Actual Expenditures for Fiscal Years 1959 Through 1963* (Washington, D.C.: NASA February 1965); NASA Budget Operations Division, "Status of Approved Programs," FY 1959-FY 1968, May 1968.

Table 6–25. Actual Obligations for Construction of Facilities by Fiscal Year and Program Year
(in millions)

Program Year	Program Plan[a]	FY 1963	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	Total
1963	$ 0.1	0	$0.1	$0	$0	$0	$ 0	$ 0.1
1964	4.8		0	0.4	1.0	0.6	0.3	2.4
1965	11.2			0	2.4	1.1	7.3	10.8
1966	6.2				0.8	0.4	4.1	5.3
1967	7.6					0.1	5.9	6.0
1968	0						0	0
Total	$29.9	0	$0.1	$0.4	$4.2	$2.4	$17.3	$24.4

[a] As of June 30, 1968, includes facilities planning and design.

* = Less than $100 000. Because of rounding, columns and rows may not add to totals.

Source: NASA, Budget Operations Division, "Status of Approved Programs. Construction of Facilities," FY 1959–FY 1968, June 1968; NASA, Financial Management Division, "Summary Financial Status of Programs," June 30, 1968.

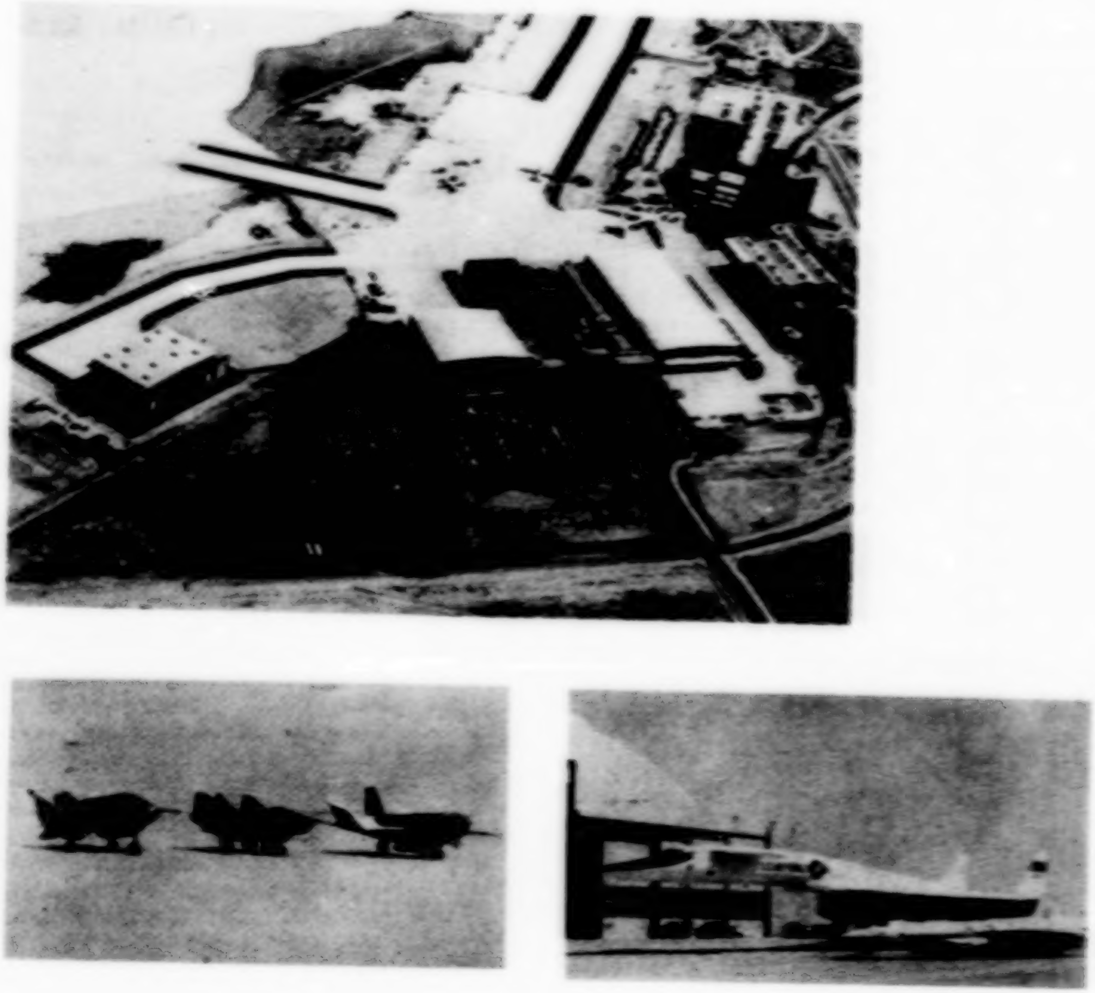
Table 6–26. Total Procurement Activity by Fiscal Year
(money amounts in millions)

	1965	1966	1967	1968	Total
Net value of contract awards	$4.0	$14.7	$21.7	$50.6	$91.0
Percentage of NASA total	*	*	*	1.2%	0.3%

* = Less than 0.5%.

Source: NASA, *Annual Procurement Report*, Fiscal Years 1965–1968 (Washington, D.C.: NASA, 1966–1968).

FLIGHT RESEARCH CENTER



Flight Research Center, Edwards, California, photographed in 1967. Research at FRC has included a joint program with the Air Force to study designs for a space shuttle, flying the wingless lifting bodies X-24A, M2-F3, and HL-10 (left to right at left); investigation of aircraft flight at speeds six times the speed of sound with the rocket-powered X-15 (foreground at right); and studies of large supersonic transports with the XB-70 (right rear).

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FLIGHT RESEARCH CENTER (FRC)

Location: Edwards, Kern County, California.

Land: 88.2 hectares (218 acres) under USAF use permit as of June 30, 1968.

Director: Paul F. Bikle (Sept. 15, 1959-).
Walter C. Williams (Director, NACA High Speed Flight Station, July 1, 1954-Sept. 15, 1959; Supervisor, NACA High Speed Flight Research Station, Fall 1949-July 1, 1954; Supervisor, NACA Muroc Flight Test Unit, September 1946-Fall 1949).

Associate Director:
De E. Beeler (April 1, 1961- ; Assistant Director, Nov. 1, 1959-April 1, 1961).

History[1]

In September 1946, 13 engineers and technicians were sent from the NACA Langley Memorial Aeronautical Laboratory to the U.S. Army Air Corps test facility at Muroc, California. The group, called the Muroc Flight Test Unit, was on temporary assignment at the Rogers Dry Lake location to begin the X-1 flight test program.[2] The first X-1 aircraft (then called XS-1) arrived at Muroc October 7 from Bell Aircraft's Niagara Falls plant. On October 11, Bell test pilot Chalmers H. (Slick) Goodlin made the first Muroc X-1 glide flight; he made the first powered flight on December 9, 1946.[3] The first supersonic flight (mach 1.06 at 13 000-meter [43 000-foot] altitude) was made October 14, 1947, by Capt. Charles E. Yeager (USAF). NACA pilot

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[1] This section was prepared by Ralph B. Jackson, Flight Research Center.

[2] Forty-Second Annual Report of the NACA, 1956 (Washington, D.C.: GPO, 1957), 6-7.

[3] *Ibid.* First preliminary glide flight test of the XS-1 had been conducted at Pinecastle Army Air Base (Florida) Jan. 19, 1946.

Herbert H. Hoover became the first civilian to exceed the speed of sound on March 4, 1948.[4]

The group was given official status as the NACA Muroc Flight Test Unit in September 1947, and by the end of 1948 it had grown to 60 persons. In the fall of 1949 it was permanently established as the NACA High Speed Flight Research Station, a division of Langley.[5] Muroc Air Force Base was renamed Edwards Air Force Base January 27, 1950. The following year, Congress approved a permanent NACA facility at Edwards with appropriations for FY 1952. The U.S. Air Force leased 70.8 hectares (175 acres) to the NACA, and in early February 1953 construction began on a large building with hangar space, instrumentation facilities, shops, and offices.

On July 1, 1954, the station was renamed the NACA High Speed Flight Station and made autonomous. That summer the 250 employees moved into the new NACA facilities, the buildings which were still in use in 1968.[6] Transition from the NACA to the National Aeronautics and Space Administation was accomplished in October 1958, and on September 27, 1959, NASA redesignated the station Flight Research Center.[7]

During its first two decades, Flight Research Center conducted tests of commercial and military aircraft, as well as flight tests of research aircraft X-1 and D-558 through the X-15. On June 8, 1959, the X-15 (No. 1) made its first glide flight, followed by the first powered flight (X-15 No. 2) on September 17, 1959.[8] No funding for the X-15 was requested for FY 1969, and the test program was expected to end in December 1968.[9]

Manned flight tests of the M2-F1 lifting-body vehicle began in 1963; the first glide flight of the heavyweight M2-F2 was made July 12, 1966.[10] The HL-10 lifting-body vehicle's first glide flight was December 22, 1966.[11] In mid 1968, a third vehicle, the USAF-developed X-24A, was being prepared for flight tests.[12]

In support of the Apollo program, the first manned test of a free-flight lunar landing simulator (the lunar landing research vehicle) was flown October 30, 1964, by the late NASA research pilot Joseph A. Walker.[13] Overall management of the XB-70 supersonic aircraft research program was transferred to Flight Research Center March 25, 1967.[14] The program was expected to be completed by January 1969.[15]

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[4] *Ibid.*, 7; NACA HSFS *X-Press* (extra edition), Oct. 14, 1957; Air Force Flight Test Center, Historical Division, *The Rocket Research Aircraft Program, 1946-1962*, AFSC Historical Publications Series 62-110V (Edwards AFB, 1962).

[5] *Forty-Second Annual Report of the NACA, 1956*, 7.

[6] *Ibid.*; NACA General Directive Number Two, March 17, 1954.

[7] NASA Release 59-225.

[8] FRC Release 2-64; Wendell H. Stillwell, *X-15 Research Results*, NASA SP-60 (Washington, D.C.: NASA, 1965), vi.

[9] NASA, *Budget Estimates*, FY 1969, II, RD 18-10.

[10] FRC Releases 17-63 and 14-66; NASA Release 66-89.

[11] FRC Release 29-66.

[12] NASA, *Budget Estimates*, FY 1969, II, RD 18-8, 18-9.

[13] FRC Release 28-64.

Mission

The mission of Flight Research Center was research in and evaluation of problems of flight, both within and outside the atmosphere, including problems of takeoff and landing; low-speed, supersonic, and hypersonic flight; and reentry:

(1) Conducting aerodynamics and aeronautics projects, such as X-15, XB-70, supersonic transport, and hypersonic research; space vehicle systems projects to study flight behavior of advanced reentry vehicles (including M-2, HL-10, and X-24A heavyweight lifting bodies); and electronics systems projects on display, guidance, and control in advanced flight missions and on improvement of systems and sensors used in biomedical monitoring, tracking, and data acquisition;

(2) Maintaining special facilities, including general-aviation aircraft for handling-qualities investigations; century series fighters used for pilot proficiency and general investigations; X-15 rocket aircraft for hypersonic research and reentry investigations; special-purpose vehicles, such as lifting bodies, variable stability aircraft, or airborne simulators; laboratory facilities; and simulation equipment;

(3) Operating a three-station radar range for tracking and data acquisition in support of flight activity.[16]

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[14] NASA Release 67-59; FRC Release 5-67.

[15] NASA, *Budget Estimates, FY 1969*, II, RD 18-8, 18-9.

[16] *Ibid.*, I, AO 2-65.

Table 6-27. Technical Facilities
(with cost in thousands)

Facility Name	Year Built	Init. Cost	Accum. Cost	Research Supported
Air Vehicle Flight Simulation Facility	1956	$ 63	$1700	Flight planning, pilot training, systems analysis, vehicle-handling qualities, and flight-data analysis
Edwards, California, Tracking Station	1958	4244	4811	Analog and digital trajectory data, telemetry reception and processing and voice communications for real-time and postflight analysis in support of high-performance aircraft test programs
Ely, Nevada, Tracking Station	1958	2322	2688	"
Beatty, Nevada, Tracking Station	1958	2122	2122	"
Communications Building (voice communications facility)	1963	68	278	Voice communication for real-time support of high-performance aircraft flight-test programs
Runway Noise Acquisition System	1964	127	141	Determination of noise produced by advanced aircraft while taking off and landing
High Temperature Loads Calibration Laboratory	1966	1712	2555	Heating, loading, and calibration for aircraft and components

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), I, Sect. 3.

Table 6–28. Property
(as of June 30; money amounts in thousands)

Category	1962[a]	1963	1964	1965	1966	1967	1968
Land in hectares (and acres)							
Owned	0	0	0	0	0	0	0
Leased	0	0	0	0	0	0	0
Buildings							
Number	NA	5	8	18	21	19[b]	33
Area owned, thousands of sq m (and sq ft)	17.8 (191)	16.0 (172)	23.8 (256)	23.9 (257)	37.6 (405)	28.6 (308)[b]	32.7 (352)
Area leased, thousands of sq m (and sq ft)	NA	0.7 (8)	NA	0.7 (7)	0.7 (8)	0	0
Value							
Land	0	0	0	0	0	0	0
Buildings	NA	$4609	$ 6 074	$ 5 458[c]	$ 6 954	$ 7 399[b]	$ 7 627
Other structures and facilities	NA	488	768	1 577	1 824	1 913	1 900
Real property	NA	$5097	$ 6 842	$ 7 035	$ 8 778	$ 9 312	$ 9 527
Capitalized equipment	$6000	$9093	$14 444	$22 172	$29 230	$29 522	$32 332

[a] Data for earlier years are not available. For definition of terms, see Introduction to Chapter Two.

[b] Number of buildings decreased because of redefinition; the 1966 figure of 21 includes 2 substations which were dropped from the 1967 report.

[c] Although number of buildings increased by 10 during FY 1965, building value dropped because of a close analysis of reporting for FY 1964 and previous years showed that figures were erroneous. The FY 1965 report was based on an actual engineering review of drawings and an onsite inspection of facilities.

NA = Not available.

Source: NASA Office of Facilities. Supplementary information was provided by E. Harlow Mortensen.

Table 6-29. Value of Real Property Components as Percentage of Total
(as of June 30; total real property value in thousands)

Component	1963[a]	1964	1965	1966	1967	1968
Land	0.0	0.0	0.0	0.0	0.0	0.0
Buildings	90.4	88.8	77.6	79.2	79.5	80.0
Other structures and facilities	9.6	11.2	22.4	20.8	20.5	20.0
	100.0	100.0	100.0	100.0	100.0	100.0
Total real property value	$5097	$6842	$7035	$8778	$9312	$9527

[a] Data for earlier years are not available.

Source: Derived from Tables 2-10 through 2-13 in Chapter Two.

Table 6-30. Personnel[a]

	1958		1959		1960		1961		1962		1963	
Employee Category	9/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31
Requested for FY ending					322		416		494		550	
Total, paid employees	292	306	340	332	408	416	447	494	538	568	616	618
Permanent	280	294	312	317	392	401	435	477	517	556	613	616
Temporary	12	12	28	15	16	15	12	17	21	12	3	2
Code group (permanent only)												
200[b]	11	11	11	12	14	14	1	1	1	1	1	1
700[c]	68	72	76	79	96	108	137	147	160	173	191	197
900	0	0	0	0	0	0	0	0	0	0	0	1
Subtotal	79	83	87	91	110	122	138	148	161	174	192	199
600[d]	0	0	0	0	0	15	15	17	20	25	30	32
500	46	47	54	50	54	38	39	47	51	61	61	62
300	21	19	23	25	33	27	39	31	42	36	67	50
100	134	145	148	151	195	199	204	234	243	260	263	273
Subtotal	201	211	225	226	282	279	297	329	356	382	421	417
Excepted: on duty	1	5	7	7	8	7	7	7	8	7	7	7
Accessions: permanent	28	22	48	37	83	28	47	77	78	80	80	67
Accessions: temporary	13	2	19	8	102	25	22	14	19	9	5	2
Military detailees	8	6	3	2	3	3	4	3	2	3	3	3

Table 6-30. Personnel (Continued)

Employee Category	1964		1965		1966		1967		1968
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Requested for FY ending	593		604		605		596		590
Total, paid employees	619	622	669	629	662	618	642	607	622
Permanent	618	620	611	608	609	607	587	582	566
Temporary	1	2	58	21	53	11	55	25	56
Code group (permanent only)									
200	1	1	1	1	1	1	1	1	0
700	197	200	198	200	201	202	201	198	197
900	1	1	1	1	1	1	1	1	1
Subtotal	199	202	200	202	203	204	203	200	198
600	37	39	39	41	42	45	43	43	45
500	58	59	54	58	64	59	59	59	52
300	62	61	65	60	59	58	49	68	73
100	262	259	253	247	241	241	233	212	198
Subtotal	419	418	411	406	406	403	384	382	368
Excepted: on duty	6	6	5	5	4	4	6	6	6
Accessions: permanent	58	44	27	32	61	54	40	NA	NA
Accessions: temporary	6	18	59	51	54	16	44	NA	NA
Military detailees	5	5	4	4	3	5	7	10	10

[a] Until Sept. 27, 1959, Flight Research Center was designated High Speed Flight Station. Data before June 30, 1960, include statistics for Western Coordination Office, which was redesignated Western Operations Office Aug. 5, 1959; see section on Western Support Office for later data on Western Operations Office.

[b] Beginning June 30, 1961, the data reflect conversion of some professionals from the 200 Code group (engineers) to the 700 Code group (aerospace technologists). For key to Code group numbers and definition of terms, see Chapter Three.

[c] Data before June 30, 1961, are for "aeronautical research scientists." Beginning June 30, 1961, the data reflect conversion of these personnel members to the 700 Code group (aerospace technologists).

[d] Before Dec. 31, 1960, the data reflect inclusion of Code group 600 personnel in the 500 Code group.

NA = Not available.

Source: NASA Personnel Division. Data through Dec. 31, 1966, from NASA Quarterly Personnel Statistical Report; data after Dec. 31, 1966, from NASA Personnel Management Information System and NASA Supplement to SF 113-A, "Monthly Report of Federal Civilian Employment Short Form."

Table 6-31. Distribution of Permanent Personnel Positions by Fiscal Year and Budget Activity[a]

Program	1959[b]	1960[b]	1961	1962	1963	1964	1965	1966	1967	1968
Manned space flight			3	6	19	50	51	34	12	0
(% of total)	(0.0)	(0.0)	(0.7)	(1.2)	(3.2)	(8.3)	(8.4)	(5.6)	(2.0)	(0.0)
Space applications			0	0	0	0	0	0	0	0
(% of total)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Unmanned investigations in space			0	1	3	3	2	1	1	0
(% of total)	(0.0)	(0.0)	(0.0)	(0.2)	(0.5)	(0.5)	(0.4)	(0.2)	(0.2)	(0.0)
Space research and technology			0	45	56	51	77	104	114	92
(% of total)	(0.0)	(0.0)	(0.0)	(8.6)	(9.5)	(8.4)	(12.7)	(17.2)	(19.3)	(16.2)
Aircraft technology[c]			438	443	361	344	317	308	312	325
(% of total)	(90.0)	(90.0)	(99.3)	(84.5)	(61.6)	(56.8)	(52.4)	(51.1)	(52.9)	(57.4)
Supporting activities[d]			0	29	147	157	158	156	151	149
(% of total)	(10.0)	(10.0)	(0.0)	(5.5)	(25.2)	(26.0)	(26.1)	(25.9)	(25.6)	(26.3)
Total FRC			441	524	586	605	605	603	590	566

[a] Based on number of actual positions reported in annual NASA Budget Estimates. FY 1961 actual figure was reported in NASA, *Budget Estimates, FY 1963;* FY 1962 actual figure was reported in NASA, *Budget Estimates, FY 1964,* etc.

[b] Actual positions data are not available for FY 1959 and FY 1960. Percentages in these two columns are based on distribution used by NASA Office of Programming, Budget Operations Division, in preparing *History of Budget Plans, Actual Obligations, and Actual Expenditures for Fiscal Years 1959 Through 1963* (Washington, D.C.: NASA, 1965), Sect. 8.

[c] FY 1961 figure represents "aircraft and missile technology."

[d] FY 1963 and later figures include tracking and data acquisition, technology utilization, and general support positions. Until FY 1963 support positions were reported with the 5 other budget activities. FY 1962 figure represents tracking and data acquisition plus technology utilization (reported as "Industrial Applications").

Source: NASA, *Budget Estimates,* FY 1963–FY 1969; NASA, Budget Operations Division.

Table 6-32. Funding by Fiscal Year
(program plan as of May 31, 1968, in millions)

Appropriation Title	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total
Research and development	0	$0.90	$1.20	$0.10	$11.50	$12.80	$ 9.50	$17.70	$10.30	$23.50	$ 87.50
Construction of facilities[a]	0	1.74	0	0	1.81	2.50	0	0	0	0	6.05
Administrative operations[b]	$3.28	4.35	5.12	7.23	7.54	9.40	10.52	9.38	9.51	9.47	75.80
Total	$3.28	$6.99	$6.32	$7.33	$20.85	$24.70	$20.02	$27.08	$19.81	$32.97	$169.35

[a] Does not include facilities planning and design.

[b] FY 1959–1962 appropriations were for salaries and expenses; FY 1963 appropriation was for research, development, and operation.

Source: NASA, Office of Programming, Budget Operations Division, *History of Budget Plans, Actual Obligations, and Actual Expenditures for Fiscal Years 1959 Through 1963* (Washington, D.C.: NASA, February 1965); NASA, Budget Operations Division, "Status of Approved Programs," FY 1959–FY 1968, May 1968.

Table 6–33. Actual Obligations for Construction of Facilities by Fiscal Year and Program Year
(in millions)

Program Year	Program Plan[a]	FY 1959	FY 1960	FY 1961	FY 1962	FY 1963	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	Total
1959	0	0	0	0	0	0	0	0	0	0	0	0
1960	$1.7		$1.6	*	*	-*	0	-*	0	0	0	$1.7
1961	0			0	0	0	0	0	0	0	0	0
1962	0.1				*	*	0	0	0	0	0	0.1
1963	1.9					$1.6	$-0.2	$0.2	$0.2	*	0	1.9
1964	2.5						*	1.3	1.2	*	-*	2.5
1965	*							0	*	0	0	*
1966	*								0	*	0	*
1967	*									0	*	*
1968	0										0	0
Total	$6.3	0	$1.6	*	$0.1	$1.7	-$0.2	$1.5	$1.4	*	*	$6.3

[a] As of June 30, 1968; includes facilities planning and design.

* = Less than $100 000. Because of rounding, columns and rows may not add to totals.

Source: NASA, Budget Operations Division, "Status of Approved Programs, Construction of Facilities," FY 1959–1968, June 1968; NASA, Financial Management Division, "Summary Financial Status of Programs," June 30, 1968.

Table 6–34. Total Procurement Activity by Fiscal Year
(money amounts in millions)

	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total
Net value of contract awards	$2.0	$1.3	$2.5	$18.3	$13.7	$14.7	$15.4	$25.5	$26.2	$119.6
Percentage of NASA total	1%	*	*	1%	*	*	*	0.5%	0.6%	0.4%

* = Less than 0.5%.

Source: NASA, Procurement and Supply Division, *NASA Procurement: October 1, 1958 to June 30, 1960* (Washington, D.C.: NASA, September 1960); NASA, *Annual Procurement Report*, Fiscal Years 1961–1968 (Washington, D.C.: NASA, 1962–1968).

GODDARD SPACE FLIGHT CENTER

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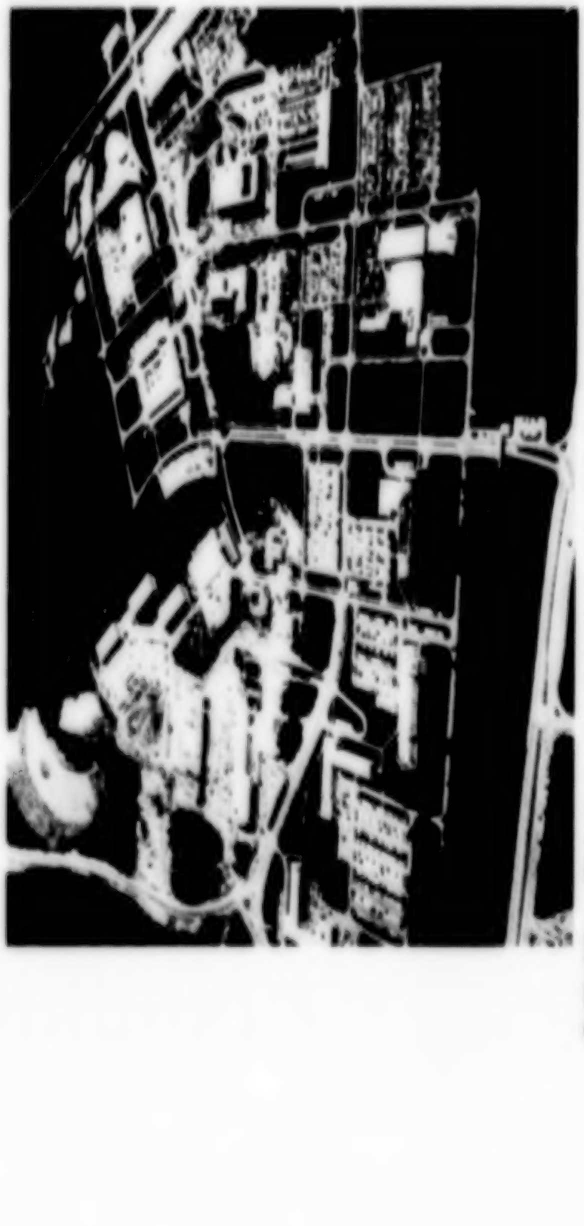

Goddard Space Flight Center, Greenbelt, Maryland, in 1967. Communications, meteorological, and scientific satellite projects managed by GSFC have included (left to right below) *Syncom 3* in 1964, *Explorer 6* Interplanetary Monitoring Platform in 1959, *OSO 1* Orbiting Solar Observatory in 1962, *OAO 2* Orbiting Astronomical Observatory in 1968, and *Tiros 10* Television Infrared Observation Satellite in 1965.

GODDARD SPACE FLIGHT CENTER (GSFC)

Location: Greenbelt, Prince Georges County, Maryland.

Land: 482.8 total hectares (1193.0 acres) at GSFC as of June 30, 1968:
- 224.3 hectares (554.2 acres) NASA-owned.
- 256.5 hectares (633.8 acres) leases and easements.
- 2.0 hectares (5.0 acres) other.

Total leased at GSFC and tracking stations, 490.5 hectares (1211.9 acres).

NASA-owned land at tracking stations, 3504.3 hectares (8659.4 acres) as of June 30, 1968:
- 3449.2 hectares (8523.16 acres), Alaska.
- 55.1 hectares (136.2 acres), Corpus Christi, Texas.

Total industrial (contractor-held, NASA-owned), 1128.7 hectares (2789.0 acres), White Sands Missile Range.

Director: John F. Clark (May 5, 1966- ; Acting July 22, 1965-May 5, 1966).
Harry J. Goett (Sept. 1, 1959-July 22, 1965).

Deputy Director:
John W. Townsend (July 22, 1965-July 12, 1968).

Associate Director:
Eugene W. Wasielewski (Oct. 16, 1960-).

History

In August 1958, before NASA was officially established, Congress authorized $3.75 million for a "Space projects center" to be located in the vicinity of Washington.[1] On August 1, Senator J. Glenn Beall of Maryland announced that the new center would be in Greenbelt "on land already owned by the federal government"; the site was part of the Dept. of Agriculture's Beltsville Agricultural Research Center.[2] With initial specifications completed by September 16, NASA Administrator T. Keith Glennan approved the first master plan in November, before the Naval Research Laboratory's Vanguard group which was to form the nucleus of the new center's personnel actually joined NASA.[3]

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[1] Public Law 85-657, Aug. 14, 1958; U.S. Congress, House, Select Committee on Astronautics and Space Exploration, *Authorizing Construction for the National Aero-*

The October 1, 1958, Executive Order announcing establishment of NASA[4] legally effected transfer of several space projects, including NRL's U.S. Scientific Satellite Project (Project Vanguard). This project to orbit a small earth satellite had been announced by President Eisenhower July 29, 1955, as part of the U.S. participation in the International Geophysical Year (1957-58),[5] and *Vanguard 1* had been launched March 17, 1958.

To accomplish the transfer with "an absolute minimum of interference" with the progress of Project Vanguard, an agreement provided for continued use of Naval Research Laboratory facilities until the Beltsville Space Center was completed; it was expected to be ready about January 1, 1960.[6] Actual transfer took place November 30, 1958, of 157 personnel members to what was later (January 1960) designated the Vanguard Division of the Beltsville Space Center. Effective December 28, another 46 persons from Naval Research Laboratory were transferred to constitute Beltsville's Space Sciences Division. A third group of 73 persons was transferred to or employed directly in the various divisions of the Center between October 1, 1958, and March 1959.[7]

On January 15, 1959, the Beltsville Center came into formal existence,[8] and a construction contract for the first two major buildings was let April

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nautics and Space Administration, Hearings, 85th Cong., 2d sess., Aug. 1, 1958 (Washington, D.C.: GPO, 1958), 1, 29-30.

The section on history of GSFC was prepared for the *Data Book* by Alfred Rosenthal, Goddard Space Flight Center.

[2] Release by Sen. J. Glenn Beall, Aug. 1, 1958; Rosholt, *Administrative History of NASA*, 79-80.

[3] Glennan, Memorandum of Record, Nov. 19, 1958, cited in Rosholt, 79. Subsequent master plans were prepared in 1962 and 1964; see U.S. Congress, House, Committee on Science and Astronautics, *Master Planning of NASA Installations*, House Rpt. No. 167, 89th Cong., 1st sess., March 15, 1965 (Washington, D.C.: GPO, 1965), 8-9.

[4] Executive Order 10783, 23 F.R. 7643 (*Federal Register*, Sept. 30, 1958).

[5] Rosholt, *Administrative History of NASA*, 4, 44-45.

[6] "Agreement Between Department of Defense and National Aeronautics and Space Administration Regarding Transfer of Records, Property, Facilities, and Civilian Personnel of Project Vanguard," cover letter, Deputy Secy. of Defense Donald A. Quarles to NASA Administrator T. Keith Glennan, Nov. 20, 1958.

[7] "Report to the House Committee on Science and Astronautics" (requested in Hearings before the Committee March 9, 1959; mimeo, prepared by NASA Personnel Division), March 17, 1959, Lists A, B, and C.

[8] NASA Beltsville Space Center, General Notice No. 1, Jan. 15, 1959, Subject: "Designation as Beltsville Space Center"; NASA General Notice, Jan. 22, 1959, Subject: "Establishment of Beltsville Space Center"; reprinted as Exhibits 6 and 7 in Append. D of Alfred Rosenthal, *Venture into Space: The Early Years of Goddard Space Flight Center*, (Washington, D.C.: NASA SP-4301, 1968). See also Exhibits 8-11 for documentation on the evolution of the Center's functions and organization.

10.[9] On May 1, NASA announced that the facility would be named Goddard Space Flight Center, in honor of Dr. Robert Hutchings Goddard (1882-1945), American pioneer in rocket research who had achieved the first launch of a liquid-propellant rocket on March 16, 1926.[10] Goddard Space Flight Center was officially dedicated on the 35th anniversary of that launch in 1961.[11]

The first satellite project for which Goddard Space Flight Center assumed overall responsibility was *Explorer 6* launched August 7, 1959. The Explorer series continued and in 1967 *Explorer 35*, launched July 19, became the first Interplanetary Monitoring Platform (IMP) anchored in lunar orbit.[12] Goddard was also responsible for a series of orbiting observatory satellites; on March 7, 1962, the first Orbiting Solar Observatory (*OSO 1*) was launched, and the first Orbiting Geophysical Observatory (*OGO 1*) September 4, 1964.[13]

In the area of applications technology, the Center managed the Tiros (Television Infrared Observation Satellite) program, whose initial flight, April 1, 1960, provided the first global cloud-cover photographs from near-circular orbit. The Tiros program evolved into the ESSA weather satellites, operational system of the Department of Commerce's Environmental Science Services Administration. The first operational ESSA satellite was launched by NASA February 3, 1966.[14] Goddard also developed the Nimbus satellites for advanced meteorological research, and on December 6, 1966, launched the first Applications Technology Satellite.[15]

Goddard contributed to development of space communications with the Echo passive balloon satellites and on July 10, 1962, launched AT&T's *Telstar 1*, the first privately built comsat. It also managed Relay (first satellite launched December 13, 1962) and Syncom (first successful launch July 26, 1963) active, repeater satellite projects. This concept was adopted by Communications Satellite Corporation for its commercial satellite system; first in this series was *Intelsat 1* ("Early Bird"), launched by NASA April 6, 1965.[16]

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[9] NASA Release 59-125.

[10] *Ibid.*; see Rosenthal, *Venture into Space*, Chap. 1.

[11] GSFC Release No. 3-10-61-5. See also Rosenthal, *Venture into Space*, Chap. 3.

[12] NASA, *Significant Achievements in Particles and Fields, 1958-1964* (Washington, D.C.: NASA SP-97, 1966); NASA Release 67-178.

[13] NASA Releases 62-59, 64-213, 64-232, and 66-313; NASA, *Significant Achievements in Solar Physics, 1958-1964* (Washington, D.C.: NASA SP-100, 1966), 68-70, 73, 75 ff.

[14] NASA Releases 60-152, 60-167; ESSA Release 66-7; NASA, *Significant Achievements in Satellite Meteorology, 1958-1964* (Washington, D.C.: NASA SP-96, 1966); NASA, *Significant Achievements in Space Applications, 1965* (Washington, D.C.: NASA SP-137, 1966); see also NASA, *Significant Achievements in Space Applications, 1966* (Washington, D.C.: NASA SP-156, 1967).

[15] NASA Release 66-308.

[16] See NASA, *Significant Achievements in Space Communications and Navigation, 1958-1964* (Washington, D.C.: NASA SP-93, 1966), for a summary of communications satellite development. For a discussion of ComSatCorp, see 35 ff.

Goddard Space Flight Center cooperated with the United Kingdom on the first international satellite, *Ariel 1* (launched April 26, 1962) and on a joint U.S. Canadian satellite project, *Alouette 1* (launched September 29, 1962). Goddard also worked with Italy on the San Marco project, and *San Marco 1* became the first satellite built and instrumented in Western Europe and launched in the United States by a European crew, December 15, 1964.[17]

In the early years of the Center, Goddard launch crews were stationed at the Eastern and Western Test Ranges (then designated Atlantic and Pacific Missile Ranges), from which they supervised launch of all unmanned scientific and applications missions using the Atlas-Agena, Delta, Centaur, and Thor-Agena launch vehicles (Ranger, Mariner, Tiros, Echo, Explorer, Nimbus, and Syncom missions). On October 1, 1965, these functions were consolidated under John F. Kennedy Space Center, NASA.[18]

Included in the 1958 transfer of the Vanguard Division from the U.S. Navy to NASA was the Minitrack tracking network (conceived for IGY Vanguard missions by Naval Research Laboratory in the spring of 1955).[19] From this early radio-interferometer concept evolved the NASA Space Tracking and Data Acquisition Network (STADAN), which combined some of the original Minitrack stations with new 26-m (85-ft) and 13.7-m (45-ft) antenna dishes, the Goddard Range and Range Rate tracking system, the satellite tracking automatic antenna system (SATAN), and enlarged automated ground-based communications links between the STADAN stations.[20]

NASA's manned space flight program under the Space Task Group, though located physically at Langley Research Center, was part of GSFC's early responsibilities. However, Space Task Group became independent January 3, 1961, and 667 persons left the Goddard staff to form what later became the Manned Spacecraft Center.[21] Goddard retained responsibility for development and operation of the Project Mercury tracking network. This global system, with its real-time capabilities, became operational in late 1961, supporting the *Mercury-Atlas 4* flight (September 13, 1961); *MA-5* (November 29, 1961); *MA-6*, the first U.S. manned orbital flight, with John H. Glenn, Jr., as pilot (February 20, 1962); and subsequent Project Mercury missions. The Manned Space Flight Network was continuously upgraded for the Gemini program, began supporting Apollo flights in 1967, and December

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[17] GSFC, *Ariel I: The First International Satellite* (Washington, D.C.: NASA SP-119, 1966): Jonathan D. Casper, "The Alouette Program: A Case Study in NASA International Cooperative Activities," NASA HHN-42, NASA Historical Office comment ed.; U.S. Congress, Senate, Committee on Aeronautical and Space Sciences, *International Cooperation and Organization for Outer Space*, Staff Rpt., Sen. Doc. No. 56, 89th Cong., 1st sess., Aug. 12, 1965 (Washington, D.C.: GPO, 1965).

[18] NASA Release 65-313. For a summary of the activity of the Goddard launch team at Pacific Missile Range-Western Test Range, see Memorandum, John J. Neilon, Deputy Director, Unmanned Launch Operations, KSC, to Alfred Rosenthal, GSFC Historian, Jan. 23, 1968.

[19] William R. Corliss, *History of the Goddard Networks*, preliminary ed. (Greenbelt, Md.: GSFC, Nov. 1, 1969), 37-41.

[20] *Ibid.*, Chap. 2.

[21] Swenson, Grimwood, and Alexander, *This New Ocean*, 303; Rosholt, *Administrative History of NASA*, Append. C.

21-27, 1968, supported *Apollo 8* on man's first escape from the earth's gravitational sphere and first journey around the moon.[32]

Working closely with the international scientific community, by mid-1968 Goddard had been responsible for some 80 major satellite missions and over 650 sounding rocket experiments to study earth-sun relationships, the nature of near-earth space, and the application of space research to meteorology, communications, and other human needs.

Mission

Goddard Space Flight Center was assigned the mission of managing scientific, communications, and meteorological satellite projects; developing sounding rocket and orbiting spacecraft experiments in basic and applied science; managing the Thor-Delta launch vehicle project; operating NASA's Space Tracking and Data Acquisition Network (STADAN) and the Manned Space Flight Tracking Network (MSFN).[33]

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[32] Swenson, Grimwood, and Alexander, *This New Ocean*, 383, 401, 419 ff; Corliss, *History of the Goddard Networks*, Chap. 3-5.

[33] NASA, *Budget Estimates*, FY 1969, IV, AO 2-34.

GODDARD INSTITUTE FOR SPACE STUDIES (GISS)

Location: 2880 Broadway, New York, N.Y. 10025.

Land: 4645.2 square meters (50 000 square feet) (3716.1 sq m [40 000 sq ft] net usable, under 10-year lease with Columbia University, January 1966 to January 1976).

Director: Robert Jastrow (Jan. 29, 1961-).

History

NASA announced establishment of the Goddard Institute for Space Studies January 29, 1961, and the Institute began formal operations in May of that year as an extension of the GSFC Theoretical Division.[1] In July 1962 it was separated organizationally from the Theoretical Division and thenceforth reported directly to the GSFC Assistant Director, Space Sciences and Satellite Applications.[2]

Originally, the Institute occupied 102.2 square meters (11 000 square feet) in Interchurch Center, 475 Riverside Drive, New York. In February 1963, it leased an additional 650.3-square-meter (7000-square-foot) area in the Columbia University-owned Watson Building,[3] and two years later added 371.6 square meters (4000 square feet) of new office space at 2900 Broadway, New York.[4] In January 1966 the research staff, management support staff, and computer personnel were brought together with the leasing of a renovated seven-story building at 2880 Broadway.[5] These facilities included a 12 000-volume library, infrared and microwave radiation laboratories, conference rooms, exhibit area, and a computer facility (one computer consisting of partly owned, partly leased components).

In addition to a permanent research staff, postdoctoral research associates were supported through NASA grants to the National Academy of Sciences-National Research Council. Staff members held adjunct faculty appointments at various universities in the New York area, and by 1968 these universities had awarded 30 Ph.D. degrees for research sponsored and supervised by Institute staff members.

Goddard Institute sponsored seminars, colloquia, and semiannual conferences and participated in summer institutes. GISS staff members published more than 300 papers in scientific journals and edited or authored 15 books between the Institute's establishment in 1961 and mid-1968.

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[1] NASA Release 61-15, approved in December 1960 by NASA Administrator T. Keith Glennan; Memorandum, Glennan to Silverstein, Dec. 14, 1960. The section on history of GISS was prepared for the *Data Book* by Alfred Rosenthal, Goddard Space Flight Center.

[2] GSFC Announcement No. 398, July 23, 1962.

[3] Letter, Lawrence Chamberlain, Vice Pres., Columbia University, to Robert Jastrow, Feb. 4, 1963.

[4] Memorandum, Arthur L. Levine, GISS Executive Officer, to Herbert Fivehouse, Chief, Management Supply and Services Div., GSFC, Sept. 30, 1964.

[5] Lease executed between General Services Administration and Columbia University, Aug. 23, 1965.

Mission

Goddard Institute for Space Studies was assigned the responsibility for research in astrophysics, planetary physics, and atmospheric physics in close collaboration with universities in the New York area:

(1) Conducting an astrophysics program including nucleosynthesis, stellar structure and evolution, galactic structure, and an observational program in infrared and submillimeter astronomy;

(2) Engaging in planetary physics studies of the origin of the solar system and the evolution of planetary bodies and their atmospheres;

(3) Undertaking basic studies in atmospheric physics on convection and radiative transfer and of general circulation and heat balance of the earth's atmosphere.

GISS Semiannual Conferences

Title	Date
Origin of the Solar System	January 1962
The Planet Jupiter	October 1962
Radio Sources and Radio Astronomy	December 1962
Origin of the Atmospheres and the Oceans	April 1963
Stellar Evolution	November 1963
The Earth-Moon System	January 1964
Nucleosynthesis	January 1965
Infrared Astronomy	April 1966
History of the Earth's Crust (Cosponsored by Columbia University)	November 1966
The Atmospheres of Mars and Venus (Cosponsored by Kitt Peak National Observatory)	February 1967
The Surface of Mars (Cosponsored by New York University and Yeshiva University)	February 1967
Supernovas (Cosponsored by Yeshiva University)	November 1967
Ocean Circulation and Climatic Changes	March 1968
Pulsars	May 1968

Table 6–35. Technical Facilities: Environmental Test Chambers
(cost in thousands)

Facility Name[a]	Year Built	Pressure (altitude)	Temperature	Init. Cost	Accum. Cost	Technological Areas Supported
Environment simulators, 2 x 2 ft (3)	1962	5×10^{-7} torr	77 to 373 K (–196° to +100°C)	$ 40	$ 52	Thermal-vacuum, thermal-balance testing of spacecraft materials, subsystems, and experiments
Environment simulators, 7 x 8 ft (2)	1962	10^{-7} torr	–	168[b]	267[b]	Thermal-vacuum, thermal-balance, thermal-gradient testing of Explorer-size spacecraft and experiments
Temperature-humidity chamber, 12 x 12 x 20 ft h.	1962		208 to 423 K (–65° to +150°C)	96	147	Temperature-humidity testing of Explorer or Agena-size spacecraft and ground support equipment
Dynamic test chamber[c] 33.5-ft dia x 59 ft l.	1962	10^{-3} mm Hg	–	878	878	Rough vacuum for structural dynamics tests
Thermal vacuum chamber, 12 x 15 ft (Test volume 10 x 15 ft)	1963	10^{-9} mm Hg	77 to 373 K (–196° to +100°C	379	382	Performance testing of optical experiments for Orbiting Astronomical Observatories
Thermal vacuum solar simulation chamber, 10 ft d. x 15 ft l.	1963	10^{-9} torr	LN_2 baffle	430	850	Research into temperature control of spacecraft
Space environment simulator, 28 x 40 ft	1964	10^{-10} torr	15 K (–258°C)	5015	5346	Thermal-balance and performance testing of spacecraft systems under simulated space conditions of vacuum, heat flux, and cold sinks

[a] All facilities except Dynamic Test Chamber and Thermal Vacuum Solar Simulation Chamber contractor-operated (Sperry Gyroscope).

[b] Average per chamber.

[c] Vacuum system Sperry-operated.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), I, Sect. 7, 55–68; Appendix A.

Table 6-36. Technical Facilities Other Than Environmental Test Chambers
(cost in thousands)

Functional Name	Facility Name	Year Built	Init. Cost	Accum. Cost	Technological Areas Supported
Vibration test facility	Vibration System (5000 lbs force)[a]	1960	$100	$100	Vibration testing of spacecraft and sounding rockets
Vibration test facility	Vibration System (5000 lbs force)[b]	NA	100	100	"
Vibration test facility	Vibration System (10 000 lbs force)	1963	348	348	"
Vibration test facility	Vibration System (28 000 lbs force)	1963	233	233	"
Antenna test range	RF Anechoic Chamber	1963	20	21	Antenna performance measurement
Antenna test range	Antenna Test Range	1964	250	340	"
Antenna control systems facility	Antenna Control Systems Facility	1964	35	65	Antenna servo control and hydraulic drive investigation; study of existing and new design concepts
Antenna test range (vertical)	Vertical Test Range	1964	140	150	Development and test of antennas for spacecraft applications
Centrifuge, 20-foot	Twenty-Foot Centrifuge	1960	55	55	Steady-state acceleration testing of spacecraft and sounding rocket components
Ultraviolet plasma facility	Ultraviolet Plasma Facility	1961	210	420	Low-temperature plasma studies
Propulsion laboratory, hot gas	Hot Gas Propulsion Laboratory	1963	300	NA	Auxiliary propulsion
Spin device dynamic test facility	Dynamic Test Chamber Spin Device	1963	53	57	Spinning of spacecraft and sounding rockets or components
Optical tracking and communications facility	Goddard Optical Research Facility	1963	230	2500	Development of precise real-time angle tracking instrumentation, precise laser ranging systems
Propulsion facility (chemical)	Chemical Propulsion Research Facility	1964	242	400	R&D of chemical reaction control systems and interactions with spacecraft subsystems
Optical facility, vacuum ultraviolet	Vacuum Optical Bench	1964	473	825	Calibration and alignment of large astronomical experiments

Table 6-36. Technical Facilities Other Than Environmental Test Chambers (continued)
(cost in thousands)

Functional Name	Facility Name	Year Built	Init. Cost	Accum. Cost	Technological Areas Supported
Optical facility, low temperature	Low Temperature Optical Facility	1964	$361	$632	Calibration and alignment of large astrono[illegible]al experiments
Optical coatings laboratory	Optical Coating Laboratory, 80 in.	1964	65	30	Deposition of thin film on large optic[illegible] visible and UV spectral regions
Spin and attitude control systems facility	Air Bearing Table	1965	125	125	Spin and attitude control system testing
Vacuum system, ultrahigh	Ultra High Vacuum System	1965	70	NA	Evaluation of spacecraft components in space thermal and pressure environment
Magnetic field component test facility	Magnetic Field Component Test Facility	1965	1075	1200	Simultaneous simulation of magnetic field, temperature, and vacuum (10^{-6}) in space
Acoustic test facility, high intensity	High Intensity Acoustic Facility	1965	130	190	Simulation of launch noise to determine and evaluate effects on spacecraft systems, subsystems, and structures
Launch phase simulator	Launch Phase Simulator	1966	4465	NA	Simulation of launch environment
Attitude control test facility	Attitude Control Test Facility	1966	1835	NA	Determination of spacecraft magnetic moment; evaluation of magnetic moment; evaluation of magnetic attitude control systems
Measurements laboratory	Measurement Systems Section	1966	65	NA	Auxiliary propulsion
Propulsion systems test facility, electric	Electric Propulsion System & Test Installation	1966	750	NA	Auxiliary propulsion systems for spacecraft station keeping and attitude control
Balancing facility, vertical	Vertical Balancing Facility	1966	78	86	Static and dynamic balancing of spacecraft and sounding rockets
Radiation environment simulation facility	Radiation Environment Simulation Facility	1967	965[c]	NA	Production of high-energy charged-particle beams, gamma radiation, and neutron beams to determine effects on materials and electrical and optical devices
Launch facility	Aerobee 350 Launcher[d]	1967	1200	NA	Space sciences
Launch facility	Tubular Boom Launcher[e]	1967	50	NA	–

[a] Sine force rate (lbs vector).
[b] Contractor-operated (Sperry Gyroscope).
[c] Including equipment and safety system; not including building structures.
[d] At White Sands Missile Range.
[e] At Barriera do Inferno Range, Natal, Brazil.
NA=Data not available.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), I, Sect. 7.

Table 6-37. Property
(as of June 30; money amounts in thousands)[a]

Category	1961	1962	1963	1964	1965	1966	1967	1968
Land in hectares (and acres)								
Owned	231.1 (571.0)[b]	231.1 (571.0)[b]	224.2 (553.9)[c]	279.2 (689.9)[d]	288.7 (713.5)[e]	3 728.6 (9 213.6)[f]	3 728.6 (9 213.6)	4 857.3 (12 002.7)[h]
Leased	NA	49.0 (121)	49.0 (121)	49.0 (121)	169.6 (419)	469.5 (1 160)	422.5 (1 043.9)	490.5 (1 211.9)
Buildings								
Number owned	NA	NA	8	30	52	216	246	190
Area owned, thousands of sq m (and sq ft)	NA	48.4 (521)	57.0 (613)	113.3 (1 219)	142.6 (1 535)	187.3 (2 016)	232.3 (2 501)	238.4 (2 566)
Area leased, thousands of sq m (and sq ft)	NA	10.7 (115)	23.1 (249)	16.5 (178)	9.9 (106)	4.6 (49)	5.1 (55)	5.1 (55)
Value of:								
Land	NA	NA	$ 58	$ 421	$ 735	$ 1 145	$ 1 291	$ 1 535
Buildings	NA	NA	13 022	32 141	44 358	58 074	68 948	81 064
Other structures and facilities	NA	NA	881	2 788	17 846	31 793	40 995	49 441
Real property	NA	NA	$13 961	$35 350	$ 62 939	$ 91 012	$111 234	$132 040
Capitalized equipment	NA	$23 000	$37 191	$59 404[g]	$110 243[g]	$199 031[g]	$258 184[g]	$371 696

[a] Including all onsite and offsite property owned or leased by GSFC, including Goddard Institute for Space Sciences in New York City and all STADAN and MSFN tracking stations. For definition of terms, see Introduction to Chapter Two. Data for FY 1960 are not available.

[b] Acquired 221.7 hectares (547.7 acres) from Dept. of Agriculture June 9, 1961, for GSFC proper; acquired 9.4 hectares (23.3 acres) from State of Alaska during February 1961 for Gilmore Creek Tracking Station. Adjusted figure; 221.8 hectares (548 acres) appeared in end-of-fiscal-year reports.

[c] Relinquished 6.9 hectares (17.06 acres) to Prince Georges County, Md., during 1962 for road construction. Adjusted figure; 248.1 hectares (613 acres) appeared in end-of-fiscal-year reports.

[d] Relinquished 0.08 hectares (0.2 acres) to Alaska during September 1963 for road construction; acquired 55.1 hectares (136.2 acres) from General Services Administration for tracking station at Corpus Christi, Tex., during June 1964. Adjusted figure; 247.7 hectares (612 acres) appeared in end-of-fiscal-year reports.

[e] Acquired 7.6 hectares (18.8 acres) from Dept. of Agriculture Dec. 21, 1964; acquired 1.9 hectares (4.8 acres) from the city of Greenbelt, Md., for interchange construction.

[f] Acquired 3.4 hectares (8.5 acres) from Public Domain in Alaska during July 1965; acquired 3436.4 hectares (8491.6 acres) for Alaska site during FY 1966.

[g] Includes capital equipment and other property at GSFC, GISS, and tracking stations and Government-furnished equipment at contractors' plants.

[h] With the disestablishment of the Western Support Office on March 1, 1968, responsibility for two industrial (contractor-held) facilities was transferred to GSFC. These were TRW-Redondo Beach (NAS 7-223 F), Redondo Beach, Calif., and New Mexico State University (NAS 7-424 F) for a 1128.7-hectare (2789-acre) antenna test range at White Sands Missile Range.

NA = Not available.

Source: NASA, Office of Facilities. Supplementary information was provided by R. M. Buckingham.

Table 6-38. Value of Real Property Components as Percentage of Total
(as of June 30; total real property value in thousands)

Component	1963[a]	1964	1965	1966	1967	1968
Land	0.4	1.2	1.1	1.3	1.3	1.2
Buildings	93.3	90.9	70.5	63.8	62.0	61.4
Other structures and facilities	6.3	7.9	28.4	34.9	36.9	37.4
	100.0	100.0	100.0	100.0	100.0	100.0
Total real property value	$13 961	$34 350	$62 939	$91 012	$111 234	$132 040

[a] Data for earlier years are not available.

Source: Derived from Tables 2-10 through 2-13 in Chapter Two.

Table 6-39. Personnel

Employee Category	1958	1959		1960		1961		1962		1963	
	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31
Requested for FY ending		800		1250		2000		2668		2749	
Total, paid employees	216	398	1117[a]	1269	1881	1599[b]	1858	2755	2858	3487	3443
Permanent	214	385	1096	1252	1741	1320	1711	2287	2579	3030	3310
Temporary	2	13	21	17	140	279	147	468	279	457	133
Code group (permanent only)											
200[c]	52	74	151	157	203	23	26	42	50	56	65
700[d]	76	141	459	525	645	604	700	980	1099	1320	1434
900	0	0	0	0	0	0	0	0	0	0	0
Subtotal	128	215	610	682	848	627	726	1022	1149	1376	1499
600[e]	–	–	–	–	106	109	166	223	246	309	404
500	31	78	249	313	364	253	373	468	535	616	634
300	53	88	154	161	215	202	261	355	404	484	516
100	2	4	83	96	208	129	185	219	245	245	257
Subtotal	86	170	486	570	893	693	985	1265	1430	1654	1811
Excepted: on duty	4	20	32	35	37	30	32	36	38	38	39
Accessions: permanent	214	187	231	200	566	266	344	621	415	477	430
Accessions: temporary	2	12	23	16	168	222	114	387	147	371	68
Military detailees	0	0	10	10	11	3	6	9	8	14	15

Table 6-39. Personnel (Continued)

Employee Category	1964		1965		1966		1967		1968
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Requested for FY ending	3700		3612		3677		3759		3782
Total, paid employees	3675	3640	3774	3560	3958	3791	3995	3752	4073
Permanent	3498	3531	3613	3489	3718	3754	3788	3702	3746
Temporary	177	109	161	71	240	37	207	50	327
Code group (permanent only)									
200[c]	67	64	63	59	58	60	60	58	56
700[d]	1542	1579	1624	1531	1660	1695	1736	1733	1762
900	0	1	0	0	0	0	0	0	0
Subtotal	1609	1644	1692	1590	1718	1755	1796	1791	1818
600[e]	439	447	461	463	531	540	548	542	540
500	649	649	647	634	680	672	682	624	619
300	541	538	558	548	544	555	534	526	552
100	260	253	255	254	245	232	228	219	217
Subtotal	1889	1887	1921	1899	2000	1999	1992	1911	1928
Excepted: on duty	40	40	33	29	32	31	32	36	37
Accessions: permanent	327	208	250	203	462	292	294	NA	NA
Accessions: temporary	83	166	105	182	186	73	141	NA	NA
Military detailees	14	11	5	3	5	8	11	10	8

[a] Space Task Group (480 employees) was transferred from Langley Research Center to GSFC in November 1959.

[b] About 660 employees were transferred from GSFC when Space Task Group was established as an independent installation in January 1961. Data henceforth include Goddard Institute for Space Studies.

[c] Beginning June 30, 1961, the data reflect conversion of some professionals from the 200 Code group (engineers) to the 700 Code group (aerospace technologists). For key to Code group numbers and definition of terms, see Chapter Three.

[d] Data before June 30, 1961, are for "aeronautical research scientists." Beginning June 30, 1961, the data reflect conversion of these personnel members to the 700 Code group (aerospace technologists).

[e] Before Dec. 31, 1960, the data reflect inclusion of Code group 600 personnel in the 500 Code group.

NA = Not Available.

Source: NASA, Personnel Division. Data through Dec. 31, 1966, from NASA Quarterly Personnel Statistical Report; data after Dec. 31, 1966, from NASA Personnel Management Information System and the NASA Supplement to SF 113-A, "Monthly Report of Federal Civilian Employment Short Form."

Table 6–40. Distribution of Permanent Personnel Positions by Fiscal Year and Budget Activity[a]

Program	1960[b]	1961	1962	1963	1964	1965	1966	1967	1968
Manned space flight		0	0	0	0	0	0	3	17
(% of total)	(60.0)	(0.0)	(0.0	(0.0)	(0.0)	(0.0)	(0.0)	(0.1)	(0.4)
Space applications		111	325	340	380	358	345	363	420
(% of total)	(7.0)	(7.4)	(13.9)	(11.0)	(10.5)	(9.7)	(9.3)	(9.6)	(11.0)
Unmanned investigations in space		855	1236	922	1141	1215	1096	1126	1139
(% of total)	(19.0)	(57.1)	(53.0)	(29.7)	(31.6)	(32.8)	(29.5)	(29.8)	(29.8)
Space research and technology		2	16	151	143	163	163	174	175
(% of total)	(1.0)	(0.2)	(0.7)	(4.9)	(4.0)	(4.4)	(4.4)	(4.6)	(4.6)
Aircraft technology		0	0	0	0	0	0	0	0
(% of total)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Supporting activities[c]		529	756	1689	1946	1968	2108	2116	2071
(% of total)	(13.0)	(35.3)	(32.4)	(54.4)	(53.9)	(53.1)	(56.8)	(55.9)	(54.2)
Total GSFC		1497	2333	3102	3610	3704	3712	3782	3822

[a] Based on number of actual positions reported in annual NASA Budget Estimates. FY 1961 actual figure was reported in NASA, *Budget Estimates, FY 1963;* FY 1962 actual figure was reported in NASA, *Budget Estimates, FY 1964,* etc.

[b] Actual positions data are not available for FY 1959 and FY 1960. Percentages in the FY 1960 column are based on distribution used by NASA Office of Programming, Budget Operations Division, in preparing *History of Budget Plans, Actual Obligations, and Actual Expenditures for Fiscal Years 1959 Through 1963* (Washington, D.C.: NASA, 1965), Sect. 8.

[c] FY 1963 and later figures include tracking and data acquisition, technology utilization, and general support positions. Until FY 1963 support positions were reported with the five other budget activities. FY 1961 and FY 1962 figures represent only tracking and data acquisition.

Source: NASA, *Budget Estimates,* FY 1963–FY 1969; NASA, Budget Operations Division.

Table 6–41. Funding by Fiscal Year
(program plan as of May 31, 1968; in millions)

Appropriations Title	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total
Research and development	$72.90	$116.70	$140.30	$171.50	$275.40	$370.50	$374.60	$353.10	$386.20	$430.50	$2691.70
Construction of facilities[a]	3.85	14.00	9.40	11.52	21.18	17.53	2.31	2.40	0.71	0.56	83.46
Administrative operations[b]	1.82	15.55	20.38	39.11	52.81	61.94	93.25	64.55	71.19	68.44	489.04
Total	$78.57	$146.25	$170.08	$222.13	$349.39	$449.97	$470.16	$420.05	$458.10	$499.50	$3264.20

[a] Does not include facilities planning and design.

[b] FY 1959–1962 appropriations were for salaries and expenses; FY 1963 appropriation was for research, development, and operation.

Source: NASA, Office of Programming, Budget Operations Division, *History of Budget Plans, Actual Obligations, and Actual Expenditures for Fiscal Years 1959 Through 1963* (Washington, D.C.: NASA, February 1965); NASA, Budget Operations Division, "Status of Approved Programs," FY 1959–1968, May 1968.

Table 6-42. Actual Obligations for Construction of Facilities by Fiscal Year and Program Year
(in millions)

Program Year	Program Plan	FY 1959	FY 1960	FY 1961	FY 1962	FY 1963	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	Total
1959	$ 3.9	$3.4	$0.2	$0.2	-*	*	*	*	0	0	0	$ 3.9
1960	13.9		5.5	6.7	$ 0.9	$ 0.5	$ 0.2	*	*	-*	0	13.9
1961	9.4			2.6	5.8	0.7	0.2	*	*	-*	-*	9.4
1962	12.0				7.2	3.9	0.5	$ 0.2	$0.2	-*	*	12.0
1963	21.4					7.9	5.2	5.1	1.1	$0.8	$0.2	20.2
1964	17.7						4.4	10.3	1.7	1.2	0.1	17.7
1965	2.4							0.7	1.6	*	*	2.4
1966	2.7								1.8	0.7	0.1	2.6
1967	0.8									*	0.7	0.7
1968	0.6										0.4	0.4
Total	$84.8	$3.4	$5.7	$9.5	$13.9	$13.0	$10.6	$16.4	$6.4	$2.7	$1.6	$83.3[a]

[a] Includes $3.4 million for tracking and data acquisition facilities.

* = Less than $100 000. Because of rounding, columns and rows may not add to totals.

Source: NASA, Budget Operations Division, "Status of Approved Programs, Construction of Facilities," FY 1959–FY 1968, June 1968; NASA Financial Management Division, "Summary Financial Status of Programs," June 30, 1968.

Table 6-43. Total Procurement Activity by Fiscal Year
(money amounts in millions)

	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total
Net value of contract awards	$76.0	$155.0	$209.3	$303.5	$382.8	$517.7	$473.8	$398.9	$471.0	$2988.0
Percentage of NASA total	23%	21%	14%	9%	8%	10%	9%	8.6%	11.4%	10.1%

Source: NASA, Procurement and Supply Division, *NASA Procurement: October 1, 1958 to June 30, 1960* (Washington, D.C.: NASA, September 1960); NASA, *Annual Procurement Report*, Fiscal Years 1961–1968 (Washington, D.C.: NASA, 1962–1968).

Table 6-44. Awards to Personnel Granted under Section 306 of the Space Act of 1958[a]

Year	Inventor	Contribution	Amount
1964	Robert C. Baumann Leopold Winkler	Spin adjusting mechanism	$2000
	William R. Cherry (with Joseph Mandelkorn, LeRC)	Solar cell for radiation environment	6000
1966	John M. Thole Wallace S. Kreisman (with Robert M. Chapman, Geophysics Corp.)	Inflation system for balloon satellites	1000
1967	John B. Schutt (with Charles M. Shai, Electro Mechanical Research Inc.)	Alkali-metal silicate protective coating	1500

[a] For complete listing of awards under this Act, see Appendix A, Sect. 1.B.

Source: NASA, Inventions and Contributions Board.

JOHN F. KENNEDY SPACE CENTER

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Kennedy Space Flight Center's Vehicle Assembly Building (above left) dwarfed the 111-meter-tall (365-foot-tall) Apollo/Saturn V-500F test vehicle and its mobile launcher in May 1966. The Launch Control Center extends diagonally from the VAB. Heavy launch row at Cape Kennedy (at left), photographed May 1968, shows NASA Complexes 36A and 36B in the foreground with Centaur pads going back to Pad 37. Mariner, Intelsat, Orbiting Astronomical Observatory, and Pioneer spacecraft have been launched on Centaur vehicles. *Freedom 7* (above), launched on the Mercury-Redstone 3, carried America's first man into space May 5, 1961. On Dec. 21, 1968, the Saturn V thrust *Apollo 8* out of the earth's field of gravity into man's first orbit of the moon.

JOHN F. KENNEDY SPACE CENTER (KSC)

Location: Kennedy Space Center, Brevard County, Florida.

Land: 35 257.7 total hectares (87 123.7 acres) as of June 30, 1968:
- –33 905.8 hectares (83 783 acres) NASA-owned.
- –1351.3 hectares (3339 acres) perpetual easements from State of Florida.
- –0.7 hectares (1.7 acres) leased.

Director: Kurt H. Debus (Dec. 20, 1963- ; Director, NASA Launch Operations Center, July 1, 1962-Dec. 30, 1963; Director, MSFC Launch Operations Directorate, July 1, 1960-July 1, 1962; at Redstone Arsenal, Alabama: Chief, Missile Firing Laboratory [part of Army Ballistic Missile Agency's Development Operations Division], Feb. 1, 1956-July 1, 1960; Chief, Missile Firing Laboratory [part of Ordnance Missile Laboratories' Guided Missile Development Division], January 1953-Feb. 1, 1956; Chief, Experimental Missiles Firing Branch [part of Technical and Engineering Division's Guided Missiles Development Group], November 1951-January 1953).

Deputy Director, Center Administration:
Albert F. Siepert (February 1963-).

Deputy Director, Center Operations:
Miles Ross (September 1967-).

History

Cape Canaveral, a barren promontory on Florida's Atlantic Coast, was selected as a missile launching site in the late 1940s. On May 11, 1949, President Truman signed a bill authorizing establishment of a launching range for guided missiles.[1] A month later the Banana River Naval Air Station (24 kilometers [15 miles] south of the Cape), which had been transferred to the United States Air Force September 1, 1948, was redesignated Joint Long Range Proving Ground and was reactivated October 1, 1949, as a joint Army-Navy-Air Force effort under executive control of the USAF Chief of Staff.[2]

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[1] Public Law 60, 81st Congress. Also see Francis E. Jarrett, Jr., and Robert A. Lindemann, "Historical Origins of NASA's Launch Operations Center to July 1, 1962," KHM-1 (KSC Historical Section, October 1964), ix, 14. The KSC history section of the *Data Book* was prepared by Francis E. Jarrett, Jr., Kennedy Space Center.

On May 16, 1950, the Department of Defense made the Air Force officially responsible for the installation: Headquarters, Joint Long Range Proving Ground, became Headquarters, Long Range Proving Ground Division. An Air Force order dated May 17 renamed Joint Long Range Proving Ground the Long Range Proving Ground Air Force Base.[3] The first rocket launched from Cape Canaveral—on July 24, 1950—was Bumper No. 8, a German V-2 with an Army-JPL WAC-Corporal second stage. On August 1, 1950, Long Range Proving Ground Air Force Base was redesignated Patrick Air Force Base. Long Range Proving Ground Division was assigned to Air Research and Development Command (ARDC) May 14, 1951, and, effective June 30, became Air Force Missile Test Center (AFMTC).[4]

In August of the same year at the Army's Redstone Arsenal in Huntsville, Alabama, organizational changes resulted in the establishment of the Technical and Engineering Division and the subsequent establishment of the Experimental Missiles Firing Branch December 1, 1951. This new Branch was formed to supervise the construction of Redstone missile facilities at Cape Canaveral Missile Test Annex and to conduct the experimental flights of Redstone missiles. Initial steps had already been taken by Redstone Arsenal to secure launch and support facilities from Air Force Missile Test Center at the Cape Canaveral Missile Test Annex. In early January 1953, the Experimental Missiles Firing Branch was redesignated Missile Firing Laboratory (MFL).[5]

The Department of Defense approved the Army's proposal for development of the Jupiter intermediate-range ballistic missile November 8, 1955, and on December 22 the Department of the Army established the Army Ballistic Missile Agency (ABMA) at Redstone Arsenal to manage both the Redstone weapon system and the Jupiter program. Missile Firing Laboratory became part of the Army Ballistic Missile Agency's Development Operations Division, and the following winter, effective December 24, 1956, 90 Missile Firing Laboratory employees were permanently assigned at Air Force Missile Test Center. By November 1958, Missile Firing Laboratory had grown to 292 civilian personnel members and had been given responsibility for launch complex design and construction for the Juno V booster (redesignated Saturn February 3, 1959).[6]

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[2] Letter, Department of the Air Force, Subject: Establishment of Advanced Headquarters, Sept. 30, 1949; Emme, *Aeronautics and Astronautics, 1915-1960*, 62.

[3] Department of the Air Force, General Order GO-38, May 17, 1950; Jarrett and Lindemann, "Historical Origins," ix. 15.

[4] Headquarters, Air Research Development Command, General Order GO-19, June 29, 1951; Jarrett and Lindemann, "Historical Origins," x, 15; Department of the Air Force, General Order GO-51, July 19, 1950.

[5] Jarrett and Lindemann, "Historical Origins," 20-23, 32.

[6] *Ibid.*, 40-49. By November 1958, ABMA was operating under Army Ordnance Missile Command (AOMC), established March 1958.

Within two weeks after the establishment of the National Aeronautics and Space Administration October 1, 1958, the first NASA payload, *Pioneer 1*, was launched from the Atlantic Missile Range (as the test range on the Cape had been redesignated May 1, 1958) under the direction of the U.S. Air Force. On November 28, Air Force Missile Test Center announced establishment of a Directorate of NASA Tests, and NASA Administrator T. Keith Glennan outlined in a May 1, 1959, memorandum the liaison, coordinative, and support functions of this office, which had been designated the Atlantic Missile Range Operations Office (AMROO).[7] Effective July 1, 1960, with the transfer of ABMA's Development Operations Division to NASA, Atlantic Missile Range Operations Office was terminated. Missile Firing Laboratory became the Launch Operations Directorate (LOD) of the new NASA Marshall Space Flight Center, functioning as the central authority at both Atlantic Missile Range (AMR) and Pacific Missile Range (PMR) for all NASA launch operations and performing liaison work with the military range commanders and their staffs.[8]

Even before the transfer, Missile Firing Laboratory had been negotiating with Air Force Missile Test Center for the reassignment of MFL facilities at Cape Canaveral Missile Test Annex to NASA. Missile Firing Laboratory had also been developing a master plan for future NASA launch facilities. With the decision in the spring of 1961 to undertake a manned lunar landing before 1970, Launch Operations Directorate and Air Force Missile Test Center initiated a joint study of lunar mission launch site facilities and requirements. NASA and the Department of Defense signed an agreement on management and funding of the lunar landing program's launch site August 24, 1961. On the same day NASA announced the decision to acquire some 32 373 hectares (80 000 acres) north and west of Cape Canaveral Missile Test Annex on which to construct facilities for manned lunar launches.[9]

NASA announced March 7, 1962, that Launch Operations Directorate would become an independent NASA field installation effective July 1, 1962. Marshall Space Flight Center retained a "Launch Vehicle Operations Division" and Launch Operations Directorate's NASA Test Support Office at Pacific Missile Range became another independent installation–the Pacific Launch Operations Office (PLOO). The rest of the Launch Operations Directorate–338 former Marshall Space Flight Center employees–formed the Launch Operations Center at Cape Canaveral. The functions of the new Center were to support NASA's launch operations, supervise large-scale construction for the manned lunar landing launch site, and continue liaison with Air Force Missile Test Center.[10]

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[7] *Ibid.*, 54; Rosholt, *Administrative History of NASA*, 81, n. 32; 123-124; Memorandum from the Administrator, May 1, 1959, Subject: Functions and Authority–NASA Atlantic Missile Range Operations Office (AMROO). Provisions of the memo were incorporated into the NASA Management Manual by General Management Instruction No. 2-2-13, Sept. 17, 1959.

[8] NASA Announcement No. 156, June 13, 1960.

[9] "Agreement Between DOD and NASA Relating to the Launch Site for the Manned Lunar Landing Program," signed by Deputy Secretary of Defense Roswell L. Gilpatric and NASA Administrator James E. Webb, Aug. 24, 1961; NASA Release 61-189.

After a series of discussions on their respective mission responsibilities at the Cape, NASA and the Department of Defense signed an agreement January 17, 1963, which provided that Air Force Missile Test Center would continue as "host agency" for the 6070-hectare (15 000-acre) Cape Canaveral launch area, but that NASA would be host agency for the new 35 207.7-hectare (87 000-acre) Merritt Island Launch Area (MILA) to the north and west. NASA and the Department of Defense would carry out their own logistic and administrative functions and would perform specific mission functions in their own behalf regardless of location (such as preparation, checkout, launch, and test evaluation).[11]

In a televised speech on Thanksgiving Day, 1963, less than a week after the assassination of the late President Kennedy, President Johnson announced that "Station No. 1 of the Atlantic Missile Range and the NASA Launch Operations Center in Florida shall hereafter be known as the John F. Kennedy Space Center." He added: "I have also acted today with the understanding and support of my friend, the Governor of Florida, Farris Bryant, to change the name of Cape Canaveral. It shall be known hereafter as Cape Kennedy."[12]

The following day, November 29, 1963, the President signed Executive Order 11129 designating both NASA and Department of Defense facilities as "John F. Kennedy Space Center." NASA officially redesignated Launch Operations Center the John F. Kennedy Space Center, NASA, December 20, and in January the Air Force redesignated its Cape Canaveral Missile Test Annex the Cape Kennedy Air Force Station.[13]

In compliance with Secretary of Defense Robert S. McNamara's November 1963 directive to consolidate Department of Defense intercontinental ballistic missile and satellite test range facilities under a central U.S. Air Force authority, the Air Force Systems Command (AFSC) established National Range Division Provisional Headquarters at Patrick Air Force Base January 2, 1964. (Air Force Systems Command had replaced Air Research and Development Command April 1, 1961.) National Range Division, as organized by AFSC May 4, set up permanent headquarters at Andrews Air Force Base, Maryland. Air Force Missile Test Center became the Air Force

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[10] NASA Circular No. 208, March 7, 1962, Subject: Establishment of the Launch Operations Center at AMR and the Pacific Launch Operations Office at PMR; NASA Release 62-53; Rosholt, *Administrative History of NASA*, Append. C; NASA General Management Instruction 2-2-9.1, Jan. 10, 1963.

[11] "Agreement between the Department of Defense and the National Aeronautics and Space Administration Regarding Management of the Atlantic Missile Range of DoD and the Merritt Island Launch Area of NASA," signed by Secretary of Defense Robert S. McNamara and NASA Administrator James E. Webb, Jan. 17, 1963; NASA Release 63-11.

[12] Cabell Phillips, *New York Times*, Nov. 29, 1963, 10.

[13] Angela C. Gresser, "Historical Aspects Concerning the Redesignation of Facilities at Cape Canaveral," KHN-1 (Cocoa Beach, Fla.: KSC Historical Section, April 1964), 15, 17; NASA Announcement 63-283, Dec. 20, 1963; Department of the Air Force, Special Order SO-GA-7, Jan. 22, 1964.

Eastern Test Range, and on May 15, 1964, the Atlantic Missile Range became the Eastern Test Range.[14]

Ground was broken for the first building in the NASA Merritt Island industrial complex January 28, 1963, and the first employees moved into new KSC headquarters in April 1965.[15] NASA discontinued the Merritt Island Launch Area designation July 26, 1965, and called the entire NASA property the John F. Kennedy Space Center, NASA, including the Industrial Area, Launch Complex 39, and other facilities.[16]

Until the first Saturn V was launched November 9, 1967, NASA launches at the Eastern Test Range took place from launch complexes at Cape Kennedy. On August 20, 1963, the Army Corps of Engineers announced that construction had begun on the Vehicle Assembly Building (then called the Vertical Assembly Building) for Launch Complex 39. This new launch complex, with its interrelated mobile launch hardware and facilities for the Saturn V launch vehicle, was the first launch facility built on NASA property north of Cape Kennedy.[17] The crawler transporter, designed to carry the launch vehicle, launch umbilical tower, and the mobile service structure from the Vehicle Assembly Building to the launch pads, lifted a mobile launcher for the first time June 22, 1965. After certain modifications, the crawler transporter completed its first successful load-carrying run January 28, 1966, and moved its first mobile service structure July 22, 1966.[18]

About 500 Manned Spacecraft Center employees joined KSC on January 1, 1965, with the transfer of the Manned Spacecraft Center Florida Operations Organization. As a result of this realignment, KSC was made responsible for final assembly, checkout, and launch of the Apollo spacecraft.[19]

On October 1, 1965, NASA consolidated its unmanned launch activities by absorbing the Goddard Space Flight Center's Launch Operations Division. Goddard personnel assigned to the Western Test Range, as well as the staff and functions of Pacific Launch Operations Office, became the KSC Western Test Range Operations Division. With this reorganization, KSC assumed responsibility for checkout and launch of all NASA vehicles except the Scout, which was under Langley Research Center management and was launched from Wallops Station and at the Western Test Range.[20]

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[14] Air Force Systems Command, Special Order SO-G-45, May 5, 1964; DOD Release 1494-63; AFSC Releases 41-5-1 and 45-R-50; Department of the Air Force, Special Order SO-GA-93, Nov. 2, 1964. For parallel developments at Western Test Range, see the section on Pacific Launch Operations Office (PLOO) in the section Former Field Activities below.

[15] AP, *Baltimore Sun*, Jan. 29, 1963; KSC Release 93-65.

[16] KSC Announcement, July 26, 1965.

[17] DOD Release 1141-63. On redesignation of the Vertical Assembly Building, see Letter, George E. Mueller, NASA Associate Administrator for Manned Space Flight, to KSC, Sept. 9, 1965.

[18] KSC Release 128-65; *Aviation Week & Space Technology*, June 20, 1966 [special KSC issue], 82 ff.; *Missiles and Rockets*, Feb. 7, 1966, 34.

[19] NASA Announcement 64-301; *MSC Roundup*, Jan. 6, 1965, 1.

[20] NASA Release 65-313; KSC Release 238-65. For background on launch activity at Western Test Range, see section on Pacific Launch Operations Office under Former Field Activities below.

Mission

Kennedy Space Center was assigned the responsibility for preparation, checkout, and launch of assigned NASA space vehicles:

(1) Designing, installing, and operating launch facilities, including ground support equipment, for manned and unmanned spacecraft and scientific satellites;

(2) Furnishing onsite technical and administrative support for all NASA programs;

(3) Conducting advanced planning and studies leading to development of new launch operations concepts and techniques.[21]

Defunct Names

Air Force Missile Test Center (AFMTC), Headquarters–formerly Long Range Proving Ground Division (renamed AFMTC June 30, 1951); renamed Headquarters, Air Force Eastern Test Range (AFETR) May 15, 1964.

Air Research and Development Command (ARDC)–replaced by Air Force Systems Command (AFSC) April 1, 1961.

Atlantic Missile Range–renamed Eastern Test Range May 15, 1964.

Banana River Naval Air Station–redesignated Joint Long Range Proving Ground June 10, 1949.

Cape Canaveral–redesignated Cape Kennedy Nov. 29, 1963.

Cape Canaveral Missile Test Annex–redesignated Cape Kennedy Air Force Station Jan. 22, 1964.

Experimental Missiles Firing Branch–became Missile Firing Laboratory January 1953.

Florida Missile Test Range–redesignated Atlantic Missile Range effective May 1, 1958.

Joint Long Range Proving Ground–redesignated Long Range Proving Ground AFB May 17, 1950.

Joint Long Range Proving Ground, Headquarters–redesignated Headquarters, Long Range Proving Ground Division May 16, 1950.

Launch Operations Center (LOC)–became John F. Kennedy Space Center, NASA, Dec. 20, 1963.

Launch Operations Directorate (LOD)–became Launch Operations Center (LOC) July 1, 1962.

Long Range Proving Ground AFB–redesignated Patrick AFB Aug. 1, 1950.

Long Range Proving Ground Division–renamed Air Force Missile Test Center June 30, 1951.

Merritt Island Launch Area (MILA)–designation discontinued July 26, 1965; area was to be called John F. Kennedy Space Center, NASA.

Missile Firing Laboratory–became MSFC Launch Operations Directorate (LOD) July 1, 1960.

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[21] U.S. Congress, House, Committee on Science and Astronautics, Subcommittee on Manned Space Flight, *1968 NASA Authorization; Hearings*, Pt. 2, 90th Cong., 1st sess., March 14-21, 1967 (Washington, D.C.: GPO, 1967), 1064; NASA Management Instruction 1142.2, June 29, 1965.

Mobile Arming Tower–name changed to Mobile Service Structure Sept. 9, 1965.

Pacific Missile Range–established June 16, 1958; part of USN responsibilities transferred to Air Force Western Test Range in May 1965; Pacific Missile Range continues as a national range under U.S. Navy management, but consists of the Sea Test Range, missile impact location stations in the Pacific, and several tracking stations.

Pad A and Pad B–redesignated Launch Area A and Launch Area B Sept. 9, 1965.

Vertical Assembly Building–redesignated Vehicle Assembly Building Sept. 9, 1965.

Table 6-45. Technical Facilities: Launch Complex 39 at Kennedy Space Center
(with costs in thousands)

Facility Name	Year Completed	Initial Cost	Accumulated Cost	Technological Areas Supported
Launch Area A[a]	1965	$24 075	$34 249.2	Launch of Saturn V
Ordnance Laboratory	1965	141	147.6	Ordnance storage; space for [illegible] retrorockets, escape rockets, and small pyrotechnic devices
Launch Equipment Shop	1965	746	763	Technical support for fabrication and repair of Saturn V launch equipment
Launch Control Center (LCC)		7 000	8 242	Central control for vehicle checkout and launch
Crawler transporters (2)	1965-1966			Transporting launch vehicle, LUT mobile launchers, and mobile service structure between park areas, Vehicle Assembly Building, and pads
Vehicle Assembly Building, High Bay and Low Bay[b]	1966		97 487.7	Four checkout cells for access and housing of the LUT during assembly and checkout of Saturn V vehicle; doorway in each bay for entrance of LUT and crawler transporter and exit with vehicle aboard as a mobile launcher. Low Bay with eight checkout cells for assembly and test of Saturn 2nd and 3rd stages.
Launch Area B[c]	1967[d]	20 957	5 431.9	Launch of Saturn V
Launch umbilical towers (3) (LUT)	1967	30 000 each	76 764.9[e]	Saturn checkout, assembly, fueling, and launch
Mobile service structure[f] (MSS)	1967	13 300	19 809.9	Inspection and malfunction operations for Saturn V spacecraft; fueling, checkout, final ordnance hookup, and final verification for Apollo spacecraft

[a] Formerly called Pad A.

[b] Formerly called Vertical Assembly Building.

[c] Formerly called Pad B.

[d] By late 1967, only launch pad and liquid hydrogen facility had been completed. When completed, Launch Area B would be identical to Launch Area A.

[e] For all three LUTs.

[f] Formerly called Mobile arming tower.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), II, Sect. 10; "NASA-KSC Quarterly Real Property Inventory as of December 31, 1967," 36 ff.

Table 6-46. Technical Facilities at Kennedy Space Center Other Than Launch Complex 39
(with costs in thousands)

Functional Name	Facility Name	Year Completed	Init. Cost	Accum. Cost	Technological Areas Supported
Radar boresight range[a]		1964	$ 95	$ 304	Radar boresighting, RFI checks; was used for Gemini-Agena docking checks
Cryogenic test facility (Nos. 1 and 2)	Cryogenic Test, Nos. 1 and 2	1964, 1966[b]	1200	1 267.6	Mercury, Gemini, and Apollo programs
Environmental systems test facility		1964	834	1 533.9	Spacecraft environmental control systems operations
Fluid test facility	Fluid Test Support Building	1964	228	508	Hypergolic propulsion systems, cryogenic fuel cell systems, life support systems
Hypergolic test facility (Nos. 1 and 2)	Hypergolic Test, Nos. 1, 2	1964	977	3 133.7	Propellant systems
Flight crew and spacecraft test facility	Operation and Checkout Building	1964	8147	28 024.6	Assembly and checkout of manned spacecraft; crew training and preflight preparations
Parachute facility	Parachute	1964	329.4	341	Storage, receiving, inspection, and packing of parachutes and other recovery equipment, flight crew equipment, and extravehicular activity (EVA) equipment
Propellant systems component laboratory	Propellent Systems Component Laboratory	1964	125	235	Receiving, disassembly, cleaning, reassembly, and testing of contaminated components of Saturn-Apollo propellant systems
Pyrotechnic installation facility	Pyrotechnic Installation	1964	1204	1 320	Manned spacecraft operations
Instrumentation support facility	Central Instrumentation Facility (CIF)	1965	5729	5 827.5	Saturn-Apollo support
Pyrotechnics test facility	Ordnance Laboratory	1965	159.4	178.3	Pyrotechnic testing, inspection, and associated electric and electronic instrumentation
Flight crew training facility[c]	Flight Crew Support Building	1966	1005.2	1 863.2	Manned spacecraft operations

[a] Including tower and control building.

[b] No. 2.

[c] Also listed in *Technical Facilities Catalog* as an MSC technical facility (Sec. 11, 163).

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), II, Sec. 10; "NASA-KSC Quarterly Real Property Inventory as of December 31, 1967," 39 ff.

Table 6-47. Technical Facilities: NASA Launch Complexes at Cape Kennedy Air Force Station
(with costs in thousands)

Launch Complex Number	Year Completed	Init. Cost	Accum. Cost[a]	Capability and Uses
12[b]	1957	$ 6 552	$ 7 335	Atlas-Agena launch vehicle; supported Ranger, Mariner, Fire, OGO, OAO, and ATS programs
17 (A&B)[c]	1957	2 982	3 445	First used for Thor-Delta, then thrust-augmented Delta (TAD) launch vehicles; supported OSO, IMP, GEOS, Biosatellite, Echo, Explorer, Tiros, Pioneer, Telstar, Relay, Syncom, and Intelsat programs
16[d]	1959[f]	3 700	4 785	Apollo static test facility for operational testing of Apollo service module and associated support equipment
13[b,e]	1958	9 706	9 849.5	Atlas-Agena launch vehicle; service structure modified to accommodate Lunar Orbiter, ATS, and OGO programs
34	1961	6 813	29 073	Assembly, checkout, and launch of Saturn IB launch vehicle
36 (A&B)[b]	1961– 1964	2 785(A) 5 693(B)	13 228[g]	Atlas-Centaur launch vehicle; supported Surveyor program
37	1963	28 476	44 004	Assembly, checkout, and launch of Saturn IB launch vehicle

[a] Total accumulated cost estimate as of Dec. 31, 1967, including all buildings, structures, and subfacilities.

[b] Contractor-operated (General Dynamics/Convair).

[c] Contractor-operated (Douglas Aircraft Co., later McDonnell Douglas Corp.).

[d] Contractor-operated (North American Rockwell Corp.).

[e] Under USAF cognizance.

[f] Year LC-16 was completed for Titan ICBM R&D test program.

[g] Including both A and B.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), II, Sect. 10; "NASA-KSC Quarterly Real Property Inventory, as of December 31, 1967," 1-23.

Table 6–48. NASA Technical Facilities at Cape Kennedy Air Force Station Other Than Launch Complexes
(with costs in thousands)

Functional Name	Facility Name	Year Completed	Init. Cost	Accum. Cost	Technological Areas Supported
Spin test facility, Delta vehicle[a]	Spin Test Building	1955	$ 250	$ 261	Balancing and pyro installation for Delta vehicles
Missile assembly facility (R&D)	Missile Assembly Building "R&D"	1956[b]	2572	2723	Saturn-Apollo assembly
Missile assembly facility (M)[c]	Missile Assembly Building "M"	1956	1239	1239	Servicing and parts cleaning laboratory
Fuel and test facility[d]	Sterlization and Assembly Building, Explosive Safe Assembly Complex	1956[e]	809	874	Checkout and spacecraft testing
Mission control center	Mission Control Center	1957	496.4	997	Checkout, launch control, training of astronauts, and tracking during Gemini program; used for Apollo checkout and tracking until adoption of Unified S Band
Missile assembly facility (S)[f]	Missile Assembly Building "S"	1957–1958	1088.9	2605	Laboratory, office, and checkout facilities for Lunar Orbiter and Biosatellite programs
Missile launch engineering support facility (E&L)	Engineering and Laboratory Building (E&L)	1958	972	1284	Office space
Spacecraft assembly and checkout facility (AE)	Spacecraft Assembly and Checkout Building (AE)	1959	512	1887	Spacecraft prelaunch assembly for unmanned launch operations
Pyrotechnics and H_2O_2 facility	Pyrotechnics/H_2O_2 Building (Passivation Building)	1960[g]	125.5	185	Recycling of suits, boots, and gloves for astronauts' protection ensemble
Missile launch engineering support facility (E&O)	E&O Building	1961	525	608	Office space for Apollo program
Saturn support facility (Hangar AF)	Hangar AF	1963	1786	1924	Administrative support offices
Spacecraft assembly and checkout facility (Hangar AO)[d]	Spacecraft Building No. 2 (Hangar AO)	1963	1128.4	1316	Prelaunch assembly and checkout of lunar and planetary spacecraft
Spacecraft test facility, unmanned (No. 1)	Spacecraft Building, No. 1 (Hangar AM)	1963		846	Laboratories, offices, and spacecraft testing facilities; used for Pioneer, ATS, and OSO satellites

Table 6-48. NASA Technical Facilities at Cape Kennedy Air Force Station Other Than Launch Complexes (Continued)
(with costs in thousands)

Functional Name	Facility Name	Year Completed	Init. Cost	Accum. Cost	Technological Areas Supported
Fuel transfer and conditioning facility	Propellant Laboratory	1964	$ 309.8	$ 394.7	Area 5/6, explosive safe complex; used during Lunar Orbiter program
Leak test facility[c]	Second Stage Leak Test Building	1964	26.1	26.2	Pressure test of helium-sphere and propellant tanks of the Delta vehicle 2nd stage

[a] Modified in 1967 for a cryogenic test facility.

[b] Modifications completed in 1962.

[c] Contractor-operated (Douglas Aircraft Co., later McDonnell Douglas Corp.).

[d] Contractor-operated (Jet Propulsion Laboratory).

[e] Modified in 1964.

[f] Contractor-operated (Boeing Aircraft Co., Inc.; General Electric Co., Inc.).

[g] Modified during 1966; contractor-operated (Bendix Corp.).

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), II, Sect. 10; "NASA–KSC Quarterly Real Property Inventory as of December 31, 1967," 24 ff.

Table 6-49. Property
(as of June 30; money amounts in thousands)[a]

Category	1962	1963[b]	1964	1965	1966	1967	1968
Land in hectares (and acres)							
Owned	5 407 (13 361)	20 064.7 (49 581)	32 062.5 (79 228)	33 746.9 (83 390.6)	33 903.5 (83 777.4)	33 903.5 (83 777.4)	33 905.8 (83 783.0)
Leased	NA	NA	0.4 (1)	5.1 (12.5)[c]	0.5 (1.3)	0.6 (1.4)	0.7 (1.7)
Buildings							
Number Owned	NA	39	64	114	200	524	611
Area of buildings owned, thousands of sq m (and sq ft)	2.1 (23)	5.8 (62)	56.6 (609)	151.4 (1 630)	274.7 (2 957)	441.8 (4 756)	472.8 (5 089)
Area of buildings leased, thousands of sq m (and sq ft)	0.9 (10)	4.0 (43)	4.9 (53)	4.9 (53)	0.9 (10)	0.9 (10)	0.9 (10)
Value							
Land	NA	$32 670	$55 653	$60 117	$60 487	$60 487	$60 516
Buildings	NA	474	14 065	42 742	110 335	186 080	242 915
Other structures and facilities	NA	5 004	36 488	73 934	137 201	285 079	378 948
Real property	NA	$38,148	$106 206	$176 793	$308 023	$531 646	$682 379
Capitalized equipment	$7 000	$10 294	$16 771	$28 203	$64 307	$94 240	$127 900

[a] Although Launch Operations Center was not officially established until July 1, 1962, the planned land acquisition began before the end of FY 1962 with funds reprogrammed from research and development. For definition of terms, see Introduction to Chapter Two.

[b] Launch Operations Center until Nov. 29, 1963; John F. Kennedy Space Center, NASA, designation announced Dec. 20, 1963.

[c] Acreage leased for Taylor Creek and Merritt Island Airport tracking stations.

NA = Data not available.

Source: NASA Office of Facilities. Supplementary information was provided by Francis E. Jarrett, Jr., Charles Hibbard, and Joe Hester.

Table 6-50. Value of Real Property Components as Percentage of Total
(as of June 30; total real property value in thousands)

Component	1963	1964	1965	1966	1967	1968
Land	85.6%	52.4%	34.0%	19.6%	11.4%	8.9%
Buildings	1.2	13.2	24.2	35.8	35.0	35.6
Other structures and facilities	13.2	34.4	41.8	44.6	53.6	55.5
	100.0	100.0	100.0	100.0	100.0	100.0
Total KSC real property value	$38 148	$106 206	$176 793	$308 023	$531 646	$682 379

Source: Derived from Tables 2-10 through 2-13 in Chapter Two.

Table 6-51. Personnel[a]

Employee Category	1962	1963		1964		1965		1966		1967		1968
	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31[b]	6/30	12/31	6/30
Requested for FY ending				1200		2205		2045		2750		2720
Total, paid employees	604	1181	1269	1625	1880	2464	2486	2669	2618	2867	2782	3044
Permanent	560	1009	1174	1434	1727	2181	2332	2433	2539	2693	2711	2917
Temporary	44	172	95	191	153	283	154	236	79	174	71	127
Code group (permanent only)												
200[c]	9	15	24	36	55	51	53	57	47	51	52	54
700[d]	156	366	429	555	691	966	1032	1059	1065	1148	1147	1263
900	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	165	381	453	591	746	1017	1085	1116	1112	1199	1199	1317
600[e]	137	190	216	266	308	345	365	391	455	537	552	564
500	188	248	299	348	414	452	482	513	540	539	539	579
300	39	123	146	172	232	270	387	409	429	415	417	454
100	31	67	60	57	27	97	13	4	3	3	4	3
Subtotal	395	628	721	843	981	1164	1247	1317	1427	1494	1512	1600
Excepted: on duty	2	6	6	14	14	10	13	13	19	18	21	24
Accessions: permanent	208	181	164	296	300	121	129	214	218	320	–	–
Accessions: temporary	79	196	91	188	144	226	141	210	57	138	–	–
Military detailees	10	8	7	6	6	5	7	7	5	4	5	5

[a] Designated Launch Operations Center from July 1, 1962, until redesignation was announced December 20, 1963. Data include figures for Daytona Beach Operation, not functionally part of KSC (see section on Headquarters in this chapter).

[b] Data for this and subsequent periods include Western Test Range Operations Division.

[c] Beginning June 30, 1961, the data reflect conversion of some professionals from the 200 Code group (engineers) to the 700 Code group (aerospace technologists). For key to Code group numbers and definition of terms, see Chapter Three.

[d] Data before June 30, 1961, are for "aeronautical research scientists." Beginning June 30, 1961, the data reflect conversion of these personnel members to the 700 Code group (aerospace technologists).

[e] Before Dec. 31, 1960, the data reflect inclusion of Code group 600 personnel in the 500 Code group.

NA = Data not available.

Source: NASA, Personnel Division. Data through Dec. 31, 1966, from NASA Quarterly Personnel Statistical Report; data after Dec. 31, 1966, from NASA Personnel Management Information System and the NASA Supplement to SF 113-A, "Monthly Report of Federal Civilian Employment Short Form."

Table 6-52. Personnel: Western Test Range Operations

Employee Category	1965	1966		1967		1968
	12/31	6/30	12/31	6/30	12/31	6/30
Total, paid employees	44	45	48	49	45	46

Source: KSC, Professional Staffing and Examining Branch.

Table 6-53. Distribution of Permanent Personnel Positions by Fiscal Year and Budget Activity[a]

Program	1962	1963	1964	1965	1966	1967	1968
Manned space flight	291	592	770	1413	1409	1518	1938
(% of total)	(87.4)	(57.4)	(48.4)	(58.2)	(54.4)	(55.8)	(66.4)
Space applications	0	0	0	0	0	0	0
(% of total)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Unmanned investigations in space	32	4	6	19	126	145	145
(% of total)	(9.6)	(0.4)	(0.4)	(0.8)	(4.9)	(5.3)	(4.0)
Space research and technology	10	2	3	0	0	0	0
(% of total)	(3.0)	(0.2)	(0.2)	(0.0)	(0.0)	(0.0)	(0.0)
Aircraft technology	0	0	0	0	0	0	0
(% of total)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Supporting activities[b]	0	434	813	996	1054	1057	834
(% of total)	(0.0)	(42.0)	(51.0)	(41.0)	(40.7)	(38.9)	(28.6)
Total	333	1032	1592	2428	2589	2720	2917

[a] Based on number of actual positions reported in annual NASA Budget Estimates. FY 1962 actual figure was reported in NASA, Budget Estimates, FY 1964; FY 1963 actual figure was reported in NASA, Budget Estimates, FY 1965, etc.

[b] FY 1963 and later figures include tracking and data acquisition, technology utilization, and general support positions. Until FY 1963 support positions were reported with the five other budget activities.

Source: NASA, Budget Estimates, FY 1963–FY 1969; NASA, Budget Operations Division.

Table 6–54. Funding by Fiscal Year
(program plan as of May 31, 1968, in millions)

Appropriation Title	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total
Research and development	0	0	0	$ 10.10	$ 57.10	$ 59.40	$134.00	$217.10	$359.50	$ 837.20
Construction of facilities[a]	$4.00	$27.77	$115.83	333.19	275.37	88.52	7.63	35.23	21.63	909.17
Administrative operations[b]	0	0	6.40	18.82	29.83	40.84	81.44	92.81	93.17	363.31
Total	$4.00	$27.77	$122.23	$362.11	$362.30	$188.76	$223.07	$345.14	$474.30	$2109.68

[a] Does not include facilities planning and design.

[b] FY 1962 appropriation was for salaries and expenses; FY 1963 appropriation was for research, development, and operation.

Source: NASA, Office of Programming, Budget Operations Division, *History of Budget Plans, Actual Obligations, and Actual Expenditures for Fiscal Years 1959 Through 1963* (Washington, D.C.: NASA, February 1965); NASA, Budget Operations Division, "Status of Approved Programs," FY 1959–FY 1968, May 1968.

Table 6–55. Actual Obligations for Construction of Facilities by Fiscal Year and Program Year
(in millions)

Program Year	Program Plan[a]	FY 1960	FY 1961	FY 1962	FY 1963	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	Total
1960	$ 4.0	$1.0	$3.0	0	0	0	0	0	0	0	$ 4.0
1961	27.8		8.5	$18.3	–*	$ 0.1	$ 0.8	$ 0.2	0	–*	27.8
1962	117.8			64.8	$ 34.0	6.9	4.7	1.7	$ 0.3	$ 4.7	117.2
1963	335.5[b]				170.4	105.7	21.9	20.7	13.0	1.3	333.9[b]
1964	277.3					85.0	124.7	51.3	12.9	2.2	276.2
1965	89.9						38.7	42.6	6.4	2.3	89.9
1966	7.9							1.5	3.4	2.6	7.4
1967	35.6								29.3	6.0	35.4
1968	22.1									13.5	13.5
Total	$917.9	$1.0	$11.5	$83.0	$204.3	$197.8	$190.9	$117.9	$62.9	$28.9	$898.2[c]

[a] As of June 30, 1968; includes facilities planning and design.

[b] Does not include $839 000 programmed (FY 1963) and obligated for modifications to the Mercury Control Center which was reported under various locations.

[c] Includes $5.5 million in tracking and data acquisition assigned KSC facilities project numbers.

* = Less than $100 000. Because of rounding, columns and rows may not add to totals.

Source: NASA, Budget Operations Division, "Status of Approved Programs, Construction of Facilities," FY 1959–1968; NASA, Financial Management Division, "Summary Financial Status of Programs," June 30, 1968.

Table 6–56. Total Procurement Activity by Fiscal Year
(money amounts in millions)

	1962	1963	1964	1965	1966	1967	1968	Total
Net value of contract awards	$36.9	$232.0	$261.3	$287.2	$292.6	$375.0	$414.2	$1899.2
Percentage of NASA total	2%	7%	6%	5%	6%	8.1%	10.0%	6.4%

Source: NASA, Procurement and Supply Division, *NASA Procurement: October 1, 1958 to June 30, 1960* (Washington, D.C.: NASA, September 1960); NASA, *Annual Procurement Report*, Fiscal Years 1961–1968 (Washington, D.C.: NASA, 1962–1968).

LANGLEY RESEARCH CENTER

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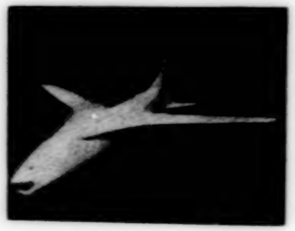

An aerial view shows the major facilities at Langley Research Center, Hampton, Virginia, in 1967. LaRC's five Lunar Orbiter probes (scale model at top left) of the moon in 1966 and 1967 provided information for the Apollo lunar landing missions. Problems of an astronaut in one-sixth gravity were studied with a laboratory device (second from top, photographed in 1963), and piloted space flight problems were investigated by use of the Rendezvous Docking Simulator (bottom far left, in a 1964 multiple-exposure action photo). Among aeronautical research projects have been the supercritical wing to improve performance and efficiency of subsonic transports (wind-tunnel test model at near left) and grooved runways to facilitate aircraft takeoffs and landings in wet weather (test photographed at Wallops Station in May 1968).

LANGLEY RESEARCH CENTER
(LaRC)

Location: Hampton, Virginia.

Land: 1692.8 total hectares (4183 acres) as of June 30, 1968.
- 173.6 hectares (429 acres) in West area, NASA-owned.
- 129.5 hectares (320 acres) in West area, USAF use permit.
- 8.9 hectares (22 acres) in East area, USAF use permit.
- 10.1 hectares (25 acres) in Town of Poquoson, Virginia, leased by Town of Poquoson.
- 1326.2 hectares (3277 acres) on Plumtree Island, Virginia, USAF use permit.
- 44.5 hectares (110 acres) in City of Newport News, Virginia, NASA-owned.

Director: Edgar M. Cortright (May 1, 1968-).

Floyd L. Thompson (May 23, 1960-May 1, 1968; Special Assistant to the NASA Administrator, May 1968-Nov. 25, 1968; Associate Director, Oct. 1, 1958-May 23, 1960; Associate Director, NACA LAL, Aug. 1, 1952-Oct. 1, 1958).

Henry J. E. Reid (†July 30, 1968; Senior Staff Associate, LaRC, May 23, 1960-June 30, 1961; Director LaRC, Oct. 1, 1958-May 23, 1960; Director, NACA LAL, May 1948-Oct. 1, 1958; Director, NACA LMAL, June 1947-May 1948; Engineer-in-Charge, NACA LMAL, Jan. 1, 1926-June 1947).

Leigh M. Griffith (Engineer-in-Charge, NACA LMAL, Nov. 1, 1922-Dec. 31, 1925).

Deputy Director:

Charles J. Donlan (Nov. 6, 1967-May 1, 1968; Associate Director, March 20, 1961-Nov. 6, 1967).

History

On October 9, 1916, the National Advisory Committee for Aeronautics appointed a subcommittee (consisting of C. D. Walcott, C. F. Marvin, and S. W. Stratton) to consider the need for a site for NACA experimental work.[1] The subcommittee's studies, coordinated with the interests of the War and Navy Departments, led to selection on November 23, 1916, of a site 6.4 kilometers (4 miles) north of Hampton, Virginia.[2] The same site had been chosen by the Army as an aircraft proving ground, and it was necessary for the NACA to obtain approval from the Secretary of War for the use of a portion of the site for NACA purposes. This approval was granted December 27, 1916.[3]

In the January 15, 1917, issue of *Aviation* magazine the announcement appeared that the Government installation near Hampton would be known as Langley Field in honor of Samuel P. Langley (1834-1906), an aviation pioneer, scientist, and astronomer and third Secretary of the Smithsonian Institution. The Langley designation was not formalized by the Department of War until August 7, 1917.[4]

Langley Field was authorized by the NACA as an experimental air station effective June 28, 1917, with a contract issued for erection of a research laboratory building at an estimated cost of $80 900.[5] On July 17, 1917, excavation began on 2.4-hectare (6-acre) site (Plot 16 in what was later called the East Area), and construction of the laboratory building was completed in June 1918 at a cost of $98 207.[6]

Plans for construction of the first NACA wind tunnel (1.5-meter [5-foot] throat) at Langley Field were approved April 29, 1918; construction began in the spring of 1919 and was completed a year later.[7] On June 20, 1919, full-scale flight-test research was authorized to facilitate comparison of airplane flight data with wind-tunnel data,[8] and flight research began that summer with two Curtiss JN-4H trainer aircraft.[9]

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[1] J. C. Hunsaker, "Forty Years of Aeronautical Research," *Smithsonian Report for 1955* (Washington, D.C.: Smithsonian Institution, 1956), 250; "Important Events in Early History of NASA," prepared for J F. Victory, Dec. 5, 1929; Michael D. Keller, "Fifty Years of Flight Research: A Chronology of the Langley Research Center, 1917-1966," HHN-65 (NASA, Historical Office, comment ed., November 1966), 9; Michael D. Keller, "A History of the NACA Langley Laboratory: 1917-1947" (NASA, Historical Office, comment ed., March 1968). This section on the history of LaRC was prepared for the *Data Book* by Robert W. Mulac, Langley Research Center.

[2] NACA, Executive Committee Minutes, Nov. 9, 1916; LaRC Public Information Office Files; *Third Annual Report of the NACA, 1917* (Washington, D.C.: GPO, 1918), 16, 20.

[3] "Important Events," 3.

[4] "Site Recommended for 'Langley Field,'" *Aviation*, 1 (Jan. 15, 1917), 397; Langley Air Force Base, 50th Anniversary (Langley AFB, Va.: November 1966).

[5] NACA, Executive Committee Minutes, July 12, 1917; *Third Annual Report of the NACA, 1917*, 20 .

[6] John F. Victory, "Day Book," Record Group (RG) 255, National Archives; Langley Job Order NAw 987.

[7] NACA, Executive Committee Minutes, April 29, 1918; *Fourth Annual Report of the NACA, 1918* (Washington, D.C.: GPO, 1920), 24; George W. Gray, *Frontiers of Flight* (New York: Alfred A. Knopf, 1948), 14-15, 34-35; *Journal of the Society of Automotive Engineers* (May 1921).

On April 22, 1920, the NACA passed a resolution, subject to the approval of the Attorney General, that the new NACA installation be named the Langley Memorial Aeronautical Laboratory.[10] During formal dedication of the Laboratory June 11, 1920, marked by the first operation of the 1.5-meter (5-foot) wind tunnel, the Attorney General's permission for the name was quoted.[11] Renamed Langley Aeronautical Laboratory May 26, 1948, by congressional action, the Laboratory became the Langley Research Center with the establishment of NASA October 1, 1958.[12]

Langley's Propeller Research Tunnel—with a 6-meter (20-foot) throat—was authorized June 25, 1926. When completed November 30, 1927, it was the largest wind tunnel in the world.[13] In 1928 the NACA cowling for radial air-cooled engines was developed, and its use led to significantly greater flight speeds with no increase in engine power.[14] In the same year the first refrigerated wind tunnel for research into prevention of icing of wings and propellers was placed in operation, and the Atmospheric Wind Tunnel was used to demonstrate high lift by means of airfoil pressure or suction slots for boundary-layer control.[15]

NACA reported to industry in 1930 results of Langley studies of optimum position of engine nacelles, the first applications of which were in the Boeing 247, Douglas DC-2, and Martin B-10 aircraft.[16] The world's first full-scale wind tunnel was built at Langley in 1930; this tunnel, with a 9- by 18-meter (30- by 60-foot) throat, was still in use for aerospace research in 1967.[17] On March 20, 1936, Langley placed in operation the world's largest high-speed wind tunnel, with a 2.4-meter (8-foot) throat.[18] Developed from use of the 4.6-meter (15-foot) spin tunnel built in 1934, the Langley free-flight wind tunnel was placed in operation April 20, 1939.[19]

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[8] NACA, Research Authorization No. 10, Langley Files.

[9] Hartley A. Soulé, "Notes on Flight Research," Aug. 4, 1948; Edward P. Warner and F. H. Norton, "Preliminary Report on Free Flight Tests," Technical Report No. 70, *Fifth Annual Report of the NACA* (Washington, D.C.: GPO, 1920), 571-599.

[10] NACA, Executive Committee Minutes, April 22, 1920.

[11] NACA, Executive Committee Minutes, June 11, 1920; D. W. Taylor speech, copy in RG 255, National Archives; *Sixth Annual Report of the NACA* (Washington, D.C.: GPO, 1921), 8.

[12] Langley, Memorandum for Staff, June 4, 1948; NACA Release, Sept. 26, 1958.

[13] *Twelfth Annual Report of the NACA, 1926* (Washington, D.C.: GPO, 1927), 6; Gray, *Frontiers of Flight*, 36-37; Keller, "A Chronology," 31.

[14] Gray, *Frontiers of Flight*, 37, 113-117.

[15] *Ibid.*, 309; *Fourteenth Annual Report of the NACA, 1928* (Washington, D.C.: GPO, 1929), 6, 25.

[16] NACA, Fortieth Anniversary brochure, 1955.

[17] Gray, *Frontiers of Flight*, 37-38; Keller, "A Chronology," 33; *Sixteenth Annual Report of the NACA, 1930* (Washington, D.C.: GPO, 1931), 7; see table on technical facilities in this section.

[18] Gray, *Frontiers of Flight*, 42-43.

[19] NACA, Fortieth Anniversary brochure; Emme, *Aeronautics and Astronautics, 1915-1960*, 37; Keller, "A Chronology," 43.

Early NACA contributions to wing improvement had resulted from the first Langley variable-density tunnel (built in 1923, destroyed by fire and rebuilt in 1927, and improved in 1929). But in the 1930s, the Langley group working on drag characteristics of wings began designs for a tunnel that would reduce turbulence by straightening and straining the airflow with a steep contraction and a series of wire screens. In 1938 the first low-turbulence tunnel was completed, and laminar flow airfoil testing began. A larger version, capable of wing section tests at large Reynolds numbers, became operative in 1941, reducing turbulence to less than 0.015 percent. Turbulence had measured 2.0 percent in the old variable-density tunnel.[20]

Construction started in 1940 on the NACA combined-loads testing machine, the basic concepts of which had been developed at Langley in 1939. Completed in 1949, this facility was the first capable of applying positive and negative forces along each of three axes and positive and negative moments about these axes, in any combination of forces, each added independently.[21]

In 1941 a Langley report established requirements for satisfactory aircraft flying qualities and provided a criterion for aircraft development that would be used generally throughout the aircraft industry.[22] The rocket aircraft research program for investigation of aircraft flight characteristics beyond the speed of sound was conceived in 1943, and on March 16, 1944, at a seminar at Langley, the NACA proposed that a jet-propelled transonic research airplane be developed.[23] During 1944 the Laboratory developed the wing-flow method (testing small semispan wings or semispan aircraft models in the transonic-airflow field over the wing of a subsonic airplane in high-speed flight). In the same year the radio telemeter was first used for transmission of aerodyanmic research data at transonic speeds from vehicles used in the "bomb drop" technique.[24]

The swept-back-wing concept for overcoming shockwave effects at critical mach numbers was formulated and experimentally confirmed in 1945.[25] During that year a report, which would become a classic reference, summarized NACA data on airfoil sections.[26] Also in 1945, Langley conducted the first launching of a two-stage rocket-propelled research model (the Tiamat) and launched the first successful rocket-boosted drag research vehicle for wing-and-body research. Both launchings were performed at the newly established Pilotless Aircraft Research Division (PARD) station at Wallops Island, Virginia.[27]

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[20] NACA, Executive Committee Minutes, Sept. 8, 1927; Gray, *Frontiers of Flight*, 36, 47-48; Keller, "A Chronology," 44.

[21] Gray, *Frontiers of Flight*, 160; Emme, *Aeronautics and Astronautics, 1915-1960*, 39, 63.

[22] Robert R. Gilruth, "Requirements for Satisfactory Flying Qualities of Airplanes," Technical Report No. 755, *Twenty-ninth Annual Report of the NACA, 1943* (Washington, D.C.: GPO, 1948), 46-57.

[23] Hunsaker, "Forty Years," 268-269; John Stack, "Compressible Flows in Aeronautics," *Journal of the Aeronautical Sciences*, XII (April 1945), 127-148, Eighth Wright Brothers Lecture presented before the Institute of Aeronautical Sciences, Washington, D.C., Dec. 17, 1944; NASA, *Fifty Years of Aeronautical Research*, EP-45 (Washington, D.C.: NASA, 1968), 31-33; Gray, *Frontiers of Flight*, 355 ff.; Emme, *Aeronautics and Astronautics, 1915-1960*, 47; *Fortieth Annual Report of the NACA*, 1954 (Washington, D.C.: GPO, 1956), 3-4.

[24] Robert R. Gilruth, "Resumé and Analysis of NACA Wing-Flow Tests," paper presented at Aeronautical Conference, Sept. 3-5, 1947, London, England; Emme, *Aeronautics and Astronautics, 1915-1960*, 48.

[25] Gray, *Frontiers of Flight*, 341-344; Emme, *Aeronautics and Astronautics, 1915-1960*, 49.

The NACA revealed on May 21, 1947, a nearly noiseless airplane with a five-bladed propeller and muffled exhaust, and on November 26 that year the first successful hypersonic-flow wind tunnel (279-millimeter [11-inch] throat) was put into operation.[28] The following year the Laboratory published a report containing the theoretical prediction of roll coupling (or inertial coupling), a problem later to be realized with short-wing, long-fuselage, high-speed aircraft.[29] In 1949 continuous transonic flow was established in the 2.4-meter (8-foot) high-speed wind tunnel, which had been altered to incorporate the slotted-throat principle developed at Langley.[30]

The transonic area rule developed at Langley was experimentally verified in transonic wind tunnels in 1951, and on January 22, 1953, the first flight test of a complete airplane model designed to incorporate the area-rule principle was made at Wallops Island.[31] An a.c. arc jet using gaseous air was first successfully operated December 19, 1956, and in 1958 the "opposed gun" technique for studying projectile impacts was conceived and placed in operation. Pilotless Aircraft Research Division launched the first successful spherical rocket motor with spin stabilization July 8, 1958. The motor had a 254-millimeter (10-inch) diameter.[32]

Space-inflatable spheres, forerunners of the Echo communications satellite, were first launched successfully from Wallops Island in 1958.[33] *Echo I* was launched August 12, 1960, culminating Langley's development of the inflatable-sphere spacecraft.[34]

On November 5, 1958, 33 Langley Research Center personnel members were officially transferred to form what became the Space Task Group, assigned the implementation of a manned satellite project (designated later that month Project Mercury). Of this group, 14 came from Langley's Pilotless

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[26] Ira H. Abbott, Albert E. von Doenhoeff, and Louis S. Stivers, Jr., "Summary of Air Foil Data," Technical Report No. 824, *Thirty-first Annual Report of the NACA, 1945* (Washington, D.C.: GPO, 1949), 259-523.

[27] Emme, *Aeronautics and Astronautics, 1915-1960,* 50, 51. See section on NASA Wallops Station in this chapter.

[28] Emme, *Aeronautics and Astronautics, 1915-1960,* 57, 58.

[29] William H. Phillips, "Appreciation and Prediction of Flying Qualities," Technical Report 927, *Thirty-fifth Annual Report of the NACA, 1949* (Washington, D.C.: GPO, 1951), 121-165.

[30] Emme, *Aeronautics and Astronautics 1915-1960,* 63; Hunsaker, "Forty Years," 269; Keller, "A Chronology," 60, 62.

[31] Emme, *Aeronautics and Astronautics, 1915-1960,* 63; Hunsaker, "Forty Years," 270; NASA, *Fifty Years of Aeronautical Research*, 36-37.

[32] Emme, *Aeronautics and Astronautics, 1915-1960,* 84, 96.

[33] NASA, *First Semiannual Report* (Washington, D.C.: GPO, 1959), 19, 23.

[34] NASA, *Third Semiannual Report* (Washington, D.C.: GPO, 1960), 62-65; *Fourth Semiannual Report* (1961), 7, 10-16.

Aircraft Research Division which had earlier in 1958 begun designs of the research booster system that became Little Joe.[35]

In the same year Langley scientists conceived the multipurpose, solid-fuel Scout launch vehicle, and a complete Scout was launched for the first time July 1, 1960.[36] On July 11, 1962, NASA announced adoption of the Lunar-Orbit Rendezvous (LOR) plan advocated by Langley for first manned lunar exploration.[37] In 1963 the phenomenon of tire hydroplaning was described to the general public as a hazard in driving automobiles on wet pavements.[38]

The first of two Project Fire spacecraft was launched April 14, 1964, recording the highest speed–1157 meters per second (37 963 fps) during reentry–that had been reached by a man-made object in free flight at that time.[39] During the same year, Project RAM (Radio Attenuation Measurement) experiments showed that ejection of a small amount of liquid into the ionized sheath around a reentering body was a promising method for dealing with radio blackout during reentry.[40]

Launched August 10, 1966, *Lunar Orbiter I* four days later became the first U.S. spacecraft to enter lunar orbit. It was the first in the LaRC-managed series of five spacecraft that obtained high-resolution photographs of various kinds of lunar surface to aid assessment of their suitability as landing sites for Apollo and Surveyor spacecraft and to contribute to knowledge of the moon.[41]

Mission

Langley Research Center was assigned responsibility for:

(1) Basic and applied research to provide the scientific and technical background necessary for (a) manned and unmanned exploration and use of space and (b) improvement in performance, safety, and utility of airborne flight; development of advanced concepts for future NASA programs; research and technical support for projects assigned to other NASA installations and other Government agencies; and support of the NASA technology utilization program.

(2) Aeronautical research to provide a rational technological base for successful development and use of practicable aircraft, such as supersonic and high-subsonic-speed transports, high-performance military aircraft, advanced hypersonic ramjet-powered vehicles, and improved V/STOL aircraft.

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[35] Memorandum, Floyd L. Thompson to all concerned, Nov. 5, 1958; Swenson, Grimwood, and Alexander, *This New Ocean*, 114, 123 ff., 132.

[36] NASA, *Fourth Semiannual Report*, 75-77.

[37] John D. Bird, "A Short History of the Development of the Lunar Orbit Rendezvous Plan at the Langley Research Center," Feb. 17, 1966; NASA Release 62-159.

[38] NASA, News Conference Transcript; NASA, TN D-2056.

[39] NASA Release 64-69; NASA, *Twelfth Semiannual Report* (Washington, D.C.: GPO, 1965), 93.

[40] Wallops Station Release 64-34; NASA Release 64-65; NASA, *Twelfth Semiannual Report*, 94.

[41] NASA Release 66-195; NASA, News Conference Transcript, Oct. 17, 1967.

(3) A broad range of research programs to provide a rational technological base for future space developments, such as studies in atmosphere entry aerothermodynamics, heat shielding, circumvention of communications blackout for space missions, establishment of requirements and advanced design concepts for controlled atmosphere entry and landing spacecraft, and for a manned orbital research laboratory.

(4) Development, procurement, and operation of the solid-propellant Scout launch vehicle; management of other spacecraft systems and experiments for evaluation of the earth's atmospheric characteristics, the radiation and micrometeoroid hazards of the earth and moon environments, the lunar gravitational field, and the properties of the lunar surface; research and development support for other unmanned spacecraft and launch vehicle projects.

(5) An extensive research program to provide guidance and technology for the formulation and execution of advanced planetary flight missions.[43]

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[43] NASA, Hq. Management Instruction, NMI 1144.5, July 15, 1964; NASA, *Budget Estimates*, FY 1969, IV, AO 2-72 through 2-75.

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Table 6–57. Technical Facilities: Wind Tunnels
(with costs in thousands)

Facility Name	Year Built	Test Section Size in Meters (and Feet)	Mach No. Range	Reynolds No. Range	Inst Cost	Accum. Cost	Research Supported
Full-scale tunnel	1930	9.1H x 18.3W x 17.1L (30H x 60W x 56L)	0.0 to 0.14	0.0 to 1 x 10^6	$ 1 029	$ 1 139	Large-scale aircraft, helicopter, spacecraft, and recovery system investigations, and free-flight dynamic model studies
Low-turbulence pressure tunnel	1940	0.9W x 2.3H (3W x 7.5H)	0.1 to 0.4	2 x 10^6 to 15 x 10^6	729	729	Effects of basic variables of shape, camber, and surface condition on complete models, and on airfoil, flap, and control surface characteristics
Spin tunnel	1941	12 sided, 6.1 across flats x 7.6H (20 across flats x 25H)	0.0 to 27.4 m per sec (0.0 to 90 fps)	0.0 to 0.62 x 10^6	100	103	Spin characteristics of aircraft and capsules, decelerators, and recovery devices in vertical descent
300-mph 7- by 10-foot tunnel	1945	2.3 x 3.1 (7 x 10)	0.0 to 483 km per hr (0.0 to 300 mph)	0.0 to 2.5 x 10^6	2 052^a	2 205^a	Full-span and semispan powered and unpowered static model testing, two-dimensional model tests, V/STOL model tests, parawings
4- by 4-foot supersonic pressure tunnel	1948	1.4H x 1.4W x 2.1L (4.5H x 4.5W x 7L)	1.25 to 2.6	1.4 x 10^6 to 6.6 x 10^6	909	3 407	Force, moment, and pressure studies
11-inch hypersonic tunnel	1949	NA	6.8, 9.6 (air) 10.5, 18.0 (helium)	0.3 to 4 x 10^6 (air) 1.2 to 10 x 10^6 (helium)	168	298	Pressure investigation, heat-transfer studies, force testing
26-inch transonic blowdown tunnel	1950	octagonal, slotted 0.6 across flats (slotted 2.2 across flats)	0.6 to 1.45	2 x 10^6 to 27 x 10^6	135	135	Flutter investigations
Unitary plan wind tunnel	1955	1.2H x 1.2W x 2.1L (4H x 4W x 7L)	1.47 to 2.86 (1) 2.29 to 4.63 (2)	(1) 0.56 x 10^6 to 7.83 x 10^6 (2) 0.76 x 10^6 to 7.78 x 10^6	15 427	15 620	Force, moment, pressure-distribution, and heat-transfer studies
8-foot transonic pressure tunnel	1958^b	2.1W x 2.1H (7.1W x 7.1H)	0.2 to 1.3 CV^c	0.3 x 10^6 to 7 x 10^6	5 495	6 793	Force, moment, pressure-distribution, flutter, and buffeting studies
20-inch hypersonic tunnel (mach 6)	1958	0.5 x 0.5 (1.6 x 1.6)	6	3 x 10^6 to 10.5 x 10^6	1 409	1 409	Heat-transfer, pressure, and force testing
11-inch ceramic-heated tunnel	1958	0.3 dia (0.9 dia)	2, 4, 6	NA	212	321	High-temperature materials
Transonic dynamics tunnel	1959^b	4.9W x 4.9H x 9.1L (16W x 16H x 30L)	0.0 to 1.2	8.5 to 10^6 (Freon 12) 3.5 to 10^6 (air)	1 100	11 110	Flutter, buffeting, ground wind loads, gust loads, and other dynamic characteristics
9- by 6-foot thermal structures tunnel	1959^b	1.8 by 2.7 (6 by 8.75)	3	2.9 x 10^6 to 18.4 x 10^6	4 269	4 254	Aerodynamic heating and loading
Hypersonic flow apparatus	1959	0.4 dia (1.25 dia)	10.03	1.3 x 10^6 to 2 x 10^6	280	335	Force, pressure, heat-transfer, and flutter testing
Mach 8 variable-density hypersonic tunnel	1960	0.5 dia (1.5 dia)	7.5 to 8	0.1 x 10^6 to 12 x 10^6	74	74	Fundamental aerodynamic and fluid dynamic investigations over large Reynolds number ranges using pressure and heat-transfer measurements
22-inch helium tunnel	1960	0.6 dia (22.5 dia)	18, 22, 26	3 x 10^6 to 15 x 10^6	997	1 289	Force, pressure distributions, and heat-transfer tests
High-speed 7- by 10-foot tunnel	1961^b	2.0H x 3.1L (6.5H x 10L)	up to 1.2	4 x 10^6 to 4.2 x 10^6	2 052^d	3 437^d	Static and dynamic studies of aerodynamic characteristics of aircraft and spacecraft

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Table 6-57. Technical Facilities: Wind Tunnels (Continued)
(with costs in thousands)

Facility Name	Year Built	Test Section Size in Meters (and Feet)	Mach No. Range	Reynolds No. Range	Init. Cost	Accum. Cost	Research Supported
16-foot transonic tunnel	1961[b]	NA	0.2 to 1.3	1.2×10^6 to 3.7×10^6	1 422	12 867	Force and pressure investigation
20-inch variable supersonic tunnel	1961	0.5W x 0.5H (1.6W x 1.6H)	2.0 to 4.5	8.5×10^6 to 20.5×10^6	354	354	Force, pressure, and flutter testing
20-inch hypersonic tunnel (mach 8.5)	1961	0.5 dia (1.75 dia)	8.5	4.8×10^6 to 7.5×10^6	507[b]	507[b]	Heat-transfer, pressure, and force testing
2-foot hypersonic facility	1961	0.6H x 0.6W x 1.4L (2H x 2W x 4.5L)	3, 4, 5, 6	0.1×10^6 to 2.4×10^6	230	406	Deployable reentry vehicles such as paraglider type and advanced launch vehicles such as winged reusable systems; high-altitude exhaust-plume aerodynamic interference
20-inch hypersonic arc-heated tunnel	1962	0.5 dia (1.6 dia)	3, 4, 6, 10	NA	560	767	Tests of reentry materials
Hotshot tunnel	1962	0.6 dia (2 dia)	12 to 28 (nitrogen) to 60 with helium	0.01×10^6 to 1×10^6 (nitrogen)	140	140	Force and moment, pressure distribution, and heat-transfer-rate studies on reentry configurations; high-energy flows
1-foot hypersonic arc tunnel	1963	0.3 dia (1 dia)	12	0.01×10^6 to 0.02×10^6	226	226	High-enthalpy hypersonic fluid mechanics
Continuous-flow hypersonic tunnel	1963	0.8 x 0.8 (2.5 x 2.5)	10, 12	0.4×10^6 to 2.5×10^6	6 396	6 396	Heat-transfer, aerodynamic tests
Pilot model expansion tube	1963	NA	2 to 3 (shock tube) 15 to 30 (expan. tube)	1×10^4 to 5×10^6 1×10^5 to 1×10^6	82	433	Convective heat-transfer investigations; hypervelocity gas dynamics; development of a radiative heat-transfer expansion tube
10-megawatt arc-powered tunnel	1963	0.9 x 0.9 (2 x 2)	2 to 7	5×10^4 to 5×10^5	3 715	3 730	Thermal protection materials and systems
Hypersonic nitrogen tunnel	1964	0.5 dia (1.5 dia)	18	0.155×10^6 to 0.785×10^6	570	570	Heat-transfer, pressure, and force studies
4-foot hypersonic arc tunnel	1964	0.6 and 1.2 dia (2 and 4 dia)	to 18	0.001×10^6 to 0.1×10^6	3 581	3 581	High-enthalpy hypersonic fluid mechanics
8-foot high-temperature structures tunnel	1964	2.4 dia (8 dia)	6.8, 7.7	0.06×10^6 to 3.7×10^6	10 537	10 537	Studies of structures and thermal protection for hypersonic flight
High enthalpy arc tunnel	1965	NA	2.5, 3.5, 4.0	NA	70	200	Ablation, char-layer effects, ablation sensors, protective coatings, and refractory metals
Hot gas radiation research facility	1966	NA	NA	NA	4 025	NA	Flow-field phenomena, radiation heating distribution to a flight vehicle; basic radiative properties of the gas in question at a given chemical and thermodynamic state; convective heat transfer

Table 6–57. Technical Facilities: Wind Tunnels (Continued)
(with costs in thousands)

Facility Name	Year Built	Test Section Size in Meters (and Feet)	Mach No. Range	Reynolds No. Range	Init. Cost	Accum. Cost	Research Supported
5-megawatt arc-powered tunnel	1966	1.8 dia (6 dia)	2 to 3.4	0.05×10^6 to 2×10^6	35[e]	35	Material testing for reentry heating
Hypersonic aeroelasticity tunnels	1967	0.9 dia (37 dia) mach 10 1.5 dia (60 dia) mach 20	10, 20	0.6×10^6 to 57×10^6 (mach 10) 1×10^6 to 18×10^6 (mach 20)	3 148	NA	Aeroelastic, thermal, and dynamic problems at hypersonic speeds

[a] Including costs of high-speed 7- by 10-foot tunnel and office building.
[b] Completion of last major modification.
[c] Continuously variable.
[d] Including cost of 300-mph 7- by 10-foot tunnel and office building.
[e] Less vacuum equipment.

NA = Data not available.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), I, Sect. 4; Append. B.

Table 6–58. Technical Facilities: Environmental Test Chambers
(with costs in thousands)

Functional Name	Dimensions in Meters (and feet)	Year Built	Pressure	Temperature	Init. Cost	Accum. Cost	Research Supported
Dynamics research laboratory	16.8 dia x 16.8 H (55 dia x 55 H)	1964	10^{-4} torr	–	$3213	$3689	Space vehicle systems, spacecraft structures, and launch vehicle structures
Environmental chamber	1.8 dia x 2.4 L (6 dia x 8 L)	1964	10^{-8} mm Hg	89 K (−300°F)	(included in above figure)		
Space vacuum facility	1.2–2.4 dia x 1.8–3.7 L (4–8 dia x 6–12 L)	1965	2×10^{-12} torr	5 K (−450°F)	1480	1480	Space environmental effects
Freebody dynamics facility (FBDF)	18.3-dia sphere (60-dia)	1966	0.2 mm Hg	–	1193[a]	1227	Spacecraft control systems

[a] Includes thermal control housing but excludes cost of laboratory building.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), I, Sect. 4, 4-31, 4-57, 4-59.

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Table 6-59. Technical Facilities Other Than Wind Tunnels and Environmental Test Facilities
(with costs in thousands)

Functional Name	Facility Name	Year Built	Init. Cost	Accum. Cost	Research or Technical Areas Supported
Landing impact test facility	Impacting Structures	1942	$ 448	$ 621	Vertical-landing impact tests of manned spacecraft, instrument packages and nosecones; horizontal-landing tests of aircraft and spacecraft
Structures research laboratory	Structures Research Laboratory	1942	1 699	2 471	Elevated temperature; static and dynamic testing; materials and environmental tests
Instrument research laboratory	Instrument Research Laboratory	1951	768	1 956	Optics; spectroscopy; vacuum, pressure, velocity, and density measurements; digital readout systems; cryogenics; standards; temperature measurements; radiation effects; acoustics
Landing loads track facility	Landing Loads Track	1957	2 500	4 487	Loads and motions measurement during impact; braking tests
Impact and projectile range	Impact and Projectile Range	1958	460	773	Explosive and inflight projectile studies
Whirl tower	Helicopter Apparatus	1959	40	202	Helicopter blade research; tests of rocket payloads, etc., when used as centrifugal g tower
Arc jet facility, atmospheric 2.5 megawatt	2.5 Megawatt Atmospheric Arc Jet	1961[a]	15	37	Materials testing for reentry heating
Rocket propulsion static test facility	Rocket Static Test Facility	1961	276	345	Pressure, force, strain, and temperature data
Materials jet, arc heated	Arc Heated Materials Jet	1961	50	50	Ablation, char-layer effects, ablation sensors, protective coatings, and refractory metals
Propellant mixing facility	Propellant Mixing Facility	1961	105	410	Hybrid-propellant systems; acceleration effects on propellant ballistics; space environmental effects; combustion efficiency in low L/D motors; combustible mandrel feasibility studies
Materials radiation laboratory	Materials Radiation Laboratory	1962 (and 1966)	87	1 008	Space radiation effects on spacecraft materials, components, and systems
Docking simulator (visual)	Visual Docking Simulator	1963	34	59	Docking simulation
Rendezvous docking simulator	Rendezvous Docking Simulator	1963	320	325	Rendezvous-docking studies; Apollo docking studies, separation techniques; aircraft visual landing approaches

Table 6-59. Technical Facilities Other Than Wind Tunnels and Environmental Test Facilities (Continued)
(with costs in thousands)

Functional Name	Facility Name	Year Built	Init. Cost	Accum. Cost	Research or Technical Areas Supported
Supersonic transport simulator	Fixed-Base Supersonic Transport Simulator	1964	$ 875[a]	$ 875[a]	Subsonic and supersonic aircraft performance, stability and control, air traffic control, instrumentation
Dynamics research laboratory	Dynamics Research Laboratory	1964	3 213	3 689	Space vehicle systems, spacecraft structures, and launch vehicle structures
Rocket motor test facility (spherical)	Spherical Rocket Motor Test Apparatus	1964	152	152	Investigation of flight rocket combustion phenomena, acceleration effects
Lunar orbit and letdown approach simulator (LOLA)	Lunar Orbit and Letdown Approach Simulator (LOLA)	1965	1 920	1 945	Visual simulator for navigation and control of spacecraft in vicinity of moon
Noise facility (high intensity)	High Intensity Noise Facility	1965	334	455	Noise studies
Noise facility (low frequency)	Low Frequency Noise Facility	1965	550	578	Noise and sonic boom studies; human factors
Space vacuum facility	150 Cubic Foot Space Vacuum Facility	1965	1 480	1 480	Space environmental effects
Projection planetarium	Projection Planetarium	1965	177	363	Studies of manual control using the "out the window" visual information
Solar corona simulator	Magnetic Compression Experiment	1965	500	514	Plasma physics and astrophysics
Lunar landing research facility	Lunar Landing Research Facility	1965	3 500	3 856	Lunar landing studies
Stabilization and control laboratory	Stabilization and Control Laboratory	1965	1 366	1 366	Instrumentation
Radiation effects laboratory[b]	Space Radiation Effects Laboratory (SREL)	1965	12 382	14 568	High-energy corpuscular radiation simulator for measuring effects on material specimens and electronic circuitry
Life support facility	Integrated Life Support System	1966	986	3 500	Life support systems engineering, human factors engineering
Micrometeoroid impact simulator	Particle Accelerator for Simulation of Micrometeoroid Impact	1966	766	NA	Effect of impact on materials

Table 6-59. Technical Facilities Other Than Wind Tunnels and Environmental Test Facilities (Continued)
(with costs in thousands)

Functional Name	Facility Name	Year Built	Init. Cost	Accum. Cost	Research or Technical Areas Supported
Electronic instrument laboratory	Electronic Instrument Laboratory	1966	$ 2 840	NA	Electronic and optical component development; environmental testing of components, subsystems, and systems
Noise research facility	Noise Research Laboratory	1966	270	$ 710	Noise studies
Rendezvous simulator	Virtual Image Rendezvous Simulator	1966	60[c]	60[c]	Rendezvous and station-keeping simulation
Plasma accelerator (20 megawatt)	20-Megawatt Linear Plasma Accelerator	1966	2 000	2 004	Magnetoplasmadynamic studies and reentry technology
Vehicle antenna test facility	Vehicle Antenna Test Facility	1966	3 472	3 629	Telemetry systems
Fatigue research laboratory	Fatigue Research Laboratory	1967	1 169	NA	Fatigue of aerospace materials and structural components
Life support technology laboratory	Life Support Technology Laboratory	1967	2 656	NA[d]	Life support

[a] Of this figure, $250 000 financed by FAA.

[b] Newport News, Va.

[c] Materials only; in-house construction.

[d] Construction contract awarded August 1966.

NA = Data not available.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), I, Sect. 4.

Table 6-60. Industrial Real Property
(as of June 30; money amounts in thousands)

Space Radiation Effects Laboratory[a]	1967	1968
Land in hectares	44.5	44.5
(and acres)	(110)	(110)
Buildings		
Number	1	1
Area in square meters	2 275.2	6 130.7
(and square feet)	(24 490)	(65 990)
Value		
Land	$ 6	$ 6
Buildings	10 658	15 177
Other structures and facilities	25	25
Total industrial real property	$10 689	$15 208

[a] Operated by Virginia Associated Research Center (College of William and Mary, University of Virginia, and Virginia Polytechnic Institute) under Contract No. NAS 1-4546 F. These figures are included in Table 6-67; data for earlier years not available.

Source: NASA, Office of Facilities.

Table 6-61. Property
(as of June 30; money amounts in thousands)

Category[a]	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
Land in hectares (and acres)										
Owned	174 (430)	174 (430)	174 (430)	174 (430)	218.5 (540)[b]	218.5 (540)	218.5 (540)	218.5 (540)	218.5 (540)	218.5 (540)
Leased	NA	NA	NA	NA	0 0	0.1 (0.2)	0.04 (0.1)	10.5 (26)	10.2 (25.3)	10.2 (25.3)
Buildings										
Number owned	NA	NA	NA	NA	106	82	90	96	96	101
Area of buildings owned, thousands of square meters (and square feet)	NA	NA	NA	186.6 (2 009)	183.2 (1 972)	122.6 (1 320)	123.7 (1 332)	137.6 (1 481)	161 (1 733)	177 (1 905)
Area of buildings leased, thousands of square meters (and square feet)	NA	NA	NA	NA	0 0	0.1 (1)	0.7 (7)	0.1 (1)	0 0	0 0
Value										
Land	$ 110	$ 110	$ 110	$ 110	$ 116	$ 116	$ 116	$ 116	$ 116	$ 116
Buildings	NA	NA	NA	NA	145 438	62 808	79 474	86 316	106 050	118 570
Other structures and facilities	NA	NA	NA	NA	11 704	110 040	113 360	118 293	129 119	130 902
Real property	$103 738	$116 336	$139 240	$199 148	$157 258	$172 964	$192 950	$204 725	$235 285	$249 588
Capitalized equipment	NA	NA	NA	$ 25 000	$ 33 314	$ 46 583	$ 55 288	$ 64 540	$ 83 212	$ 91 240

[a] For definition of terms, see Introduction to Chapter Two.

[b] 44.5 hectares (110 acres) acquired for Space Radiation Effects Laboratory in Newport News, Va.

NA = Data not available.

Source: NASA, Office of Facilities. Supplementary information was provided by C. R. McMath, Jr.

Table 6-62. Value of Real Property Components as Percentage of Total
(as of June 30; total real property value in thousands)

Component	1963[a]	1964	1965	1966	1967	1968
Land	0.1	0.1	0.1	*	*	*
Buildings	92.5	36.3	41.2	42.2	45.1	47.5
Other structures and facilities	7.4	63.6	58.7	57.8	54.9	52.4
	100.0	100.0	100.0	100.0	100.0	100.0
Total LaRC real property value	$157 258	$172 964	$192 950	$204 725	$235 285	$249 588

[a] Data for earlier years are not available.
* = Less than 0.1%.

Source: Derived from Tables 2-10 through 2-13 in Chapter Two.

Table 6-63. Personnel

Employee Category	1958		1959		1960		1961		1962		1963	
	9/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31
Requested for FY ending					3333		3220		3330		4000	
Total, paid employees	3368	3501	3795	3456[a]	3191[b]	3208	3338	3460	3894	4007	4220	4234
Permanent	3322	3458	3765	3452	3189	3201	3295	3441	3766	3984	4112	4204
Temporary	46	43	30	4	2	7	43	19	128	23	108	30
Code group (permanent only)												
200[c]	302	300	335	298	285	285	83	81	80	75	91	89
700[d]	847	862	1009	857	845	842	1106	1112	1285	1347	1445	1489
900	0	0	0	0	0	0	0	0	0	0	0	4
Subtotal	1149	1162	1344	1155	1130	1127	1189	1193	1365	1422	1536	1582
600[e]	0	0	0	0	0	85	94	110	124	138	140	165
500	362	397	463	425	364	275	299	331	385	432	[illegible]	436
300	266	290	302	268	243	275	291	337	412	414	430	452
100	1545	1609	1656	1604	1452	1439	1422	1470	1480	1578	1566	1569
Subtotal	2173	2296	2421	2297	2059	2074	2106	2248	2401	2562	2576	2622
Excepted: on duty	9	31	46	40	36	37	38	37	40	38	38	36
Accessions: permanent	237	507	445	302	91	164	237	331	513	444	313	277
Accessions: temporary	88	13	54	20	2	12	51	25	81	18	134	34
Military detailees	20	13	11	13	11	12	10	16	19	24	31	32

Table 6-63. Personnel (Continued)

Employee Category	1964		1965		1966		1967		1968
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Requested for FY ending	4296		4278		4238		4179		4236
Total, paid employees	4330	4329	4371	4263	4485	4296	4405	4211	4219
Permanent	4255	4298	4285	4237	4280	4235	4227	4168	4037
Temporary	75	31	86	26	205	61	178	43	182
Code group (permanent only)									
200[c]	87	88	84	82	84	84	81	65	51
700[d]	1511	1519	1561	1554	1563	1541	1557	1565	1553
900	5	5	5	5	5	5	5	6	6
Subtotal	1603	1612	1650	1641	1652	1630	1643	1636	1610
600[e]	182	198	199	194	200	211	206	215	207
500	456	454	428	462	499	499	491	469	437
300	468	492	507	514	965	985	1022	994	1022
100	1546	1542	1501	1426	964	910	865	854	761
Subtotal	2652	2686	2635	2596	2628	2605	2584	2532	2427
Excepted: on duty	36	35	28	28	28	28	27	28	26
Accessions: permanent	229	198	205	177	248	187	189	NA	NA
Accessions: temporary	70	124	85	134	238	70	170	NA	NA
Military detailees	31	21	16	14	8	6	5	5	5

[a] Space Task Group, with 480 employees, was transferred from Langley Research Center to Goddard Space Flight Center in November 1959.

[b] With establishment of Wallops Station as an independent installation, 225 employees were transferred in January 1960 from Langley to Wallops reports.

[c] Beginning June 30, 1961, the data reflect conversion of some professionals from the 200 Code group (engineers) to the 700 Code group (aerospace technologists). For key to Code group numbers and definition of terms, see Chapter Three.

[d] Data before June 30, 1961, are for "aeronautical research scientists." Beginning June 30, 1961, the data reflect conversion of these personnel members to the 700 Code group (aerospace technologists).

[e] Before Dec. 31, 1960, the data reflect inclusion of Code group 600 personnel in the 500 Code group.

NA = Data not available.

Source: NASA, Personnel Division. Data from Dec. 31, 1966, from NASA Quarterly Personnel Statistical Report; data after Dec. 31, 1966, from NASA Personnel Management Information System and NASA Supplement to SF 113-A, "Monthly Report of Federal Civilian Employment Short Form."

Table 6-64. Distribution of Permanent Personnel Positions by Fiscal Year and Budget Activity[a]

Program	1959[b]	1960[b]	1961	1962	1963	1964	1965	1966	1967	1968
Manned space flight			176	24	56	47	24	37	23	46
(% of total)	(5.0)	(10.0)	(5.4)	(0.7)	(1.4)	(1.1)	(0.6)	(0.9)	(0.6)	(1.1)
Space applications			100	34	25	25	17	29	14	17
(% of total)	(2.0)	(5.0)	(3.0)	(0.9)	(0.6)	(0.6)	(0.4)	(0.7)	(0.3)	(0.4)
Unmanned investigations in space			545	140	163	234	228	249	266	230
(% of total)	(4.0)	(5.0)	(16.6)	(3.8)	(4.0)	(5.5)	(5.4)	(5.9)	(6.4)	(5.7)
Space research and technology			636	2516	2203	1660	1741	1756	1637	1632
(% of total)	(4.0)	(15.0)	(19.3)	(68.4)	(54.0)	(38.8)	(41.0)	(41.5)	(39.3)	(40.4)
Aircraft technology[c]			1350	956	752	650	718	737	811	846
(% of total)	(85.0)	(60.0)	(41.1)	(26.0)	(18.4)	(15.2)	(16.9)	(17.4)	(19.5)	(21)
Supporting activities[d]			480	9	881	1663	1516	1425	1410	1266
(% of total)	(0.0)	(5.0)	(14.6)	(0.2)	(21.6)	(38.8)	(35.7)	(33.6)	(33.9)	(31.4)
Total LaRC			3287	3679	4080	4279	4244	4233	4161	4037

[a] Based on number of actual positions reported in annual NASA Budget Estimates. FY 1961 actual figure was reported in NASA, *Budget Estimates*, FY 1963; FY 1962 actual figure was reported in NASA, *Budget Estimates*, FY 1964, etc.

[b] Actual positions data are not available for FY 1959 and FY 1960. Percentages in these two columns are based on distribution used by NASA Office of Programming, Budget Operations Division, in preparing *History of Budget Plans, Actual Obligations, and Actual Expenditures for Fiscal Years 1959 Through 1963* (Washington, D.C.: NASA, 1965), Sect. 8.

[c] FY 1961 figure represents "Aircraft and missile technology."

[d] FY 1963 and later figures include tracking and data acquisition, technology utilization, and general support positions. Until FY 1963 support positions were reported with the five other budget activities. FY 1961 and FY 1962 figures are for only tracking and data acquisition.

Source: NASA, *Budget Estimates*, FY 1963–FY 1969; NASA, Budget Operations Division.

Table 6-65. Funding by Fiscal Year
(program plan as of May 31, 1968, in millions)

Appropriation Title	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total
Research and development	$ 7.00	$13.90	$18.50	$14.50	$ 46.00	$ 78.40	$106.90	$124.20	$ 91.20	$ 82.30	$ 582.90
Construction of facilities[a]	10.84	4.51	12.30	6.91	9.84	9.61	3.54	8.25	6.10	0	71.90
Administrative operations[b]	31.38	33.00	39.15	46.59	51.63	52.12	59.01	63.53	64.33	62.20	502.94
Total	$49.22	$51.41	$69.95	$68.00	$107.47	$140.13	$169.45	$195.98	$161.63	$144.50	$1157.74

[a] Does not include facilities planning and design.

[b] FY 1959–1962 appropriations were for salaries and expenses; FY 1963 appropriation was for research, development, and operation.

Source: NASA, Office of Programming, Budget Operations Division, *History of Budget Plans, Actual Obligations, and Actual Expenditures for Fiscal Years 1959 Through 1963* (Washington, D.C.: NASA, February 1965), NASA, Budget Operations Division, "Status of Approved Programs," FY 1959–FY 1968, May 1968.

Table 6-66. Actual Obligations for Construction of Facilities by Fiscal Year and Program Year
(in millions)

Program Year	Program Plan[a]	FY 1959	FY 1960	FY 1961	FY 1962	FY 1963	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	Total
1959	$10.8	$2.4	$1.7	$4.5	$ 1.4	$0.3	$0.2	*	*	$0.1	0	$10.8
1960	4.5		2.6	0.7	1.1	0.1	*	*	0	0	0	4.5
1961	12.3			1.8	7.9	1.7	0.4	$0.1	$0.1	0.3	*	12.3
1962	6.9				5.0	1.5	0.3	*	*	*	*	6.9
1963	10.1					3.0	4.2	1.3	1.0	0.5	*	10.0
1964	9.9						3.9	2.5	1.0	1.8	$0.4	9.7
1965	4.3							3.1	0.6	0.2	*	4.0
1966	9.2								2.3	5.5	0.5	8.3
1967	6.5									1.4	4.8	6.3
1968	0										0	0
Total	$74.5	$2.4	$4.4	$7.0	$15.5	$6.5	$9.0	$7.2	$5.1	$9.8	$6.0	$72.9

[a] As of June 30, 1968; includes facilities planning and design.

* = Less than $100 000. Because of rounding, columns and rows may not add to totals.

Source: NASA, Budget Operations Division, "Status of Approved Programs, Construction of Facilities," FY 1959–FY 1968, June 1968; NASA, Financial Management Division, "Summary Financial Status of Programs," June 30, 1968.

Table 6–67. Total Procurement Activity by Fiscal Year
(money amounts in millions)

	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total
Net value of contract awards	$118.5	$66.9	$70.8	$83.4	$103.9	$130.8	$139.6	$142.7	$103.6	$960.2
Percentage of NASA total	35%	9%	5%	2%	2%	3%	3%	3.1%	2.5%	3.3%

Source: NASA, Procurement and Supply Division, *NASA Procurement: October 1, 1958 to June 30, 1960* (Washington, D.C.: September 1960); NASA, *Annual Procurement Report*, Fiscal Years 1961–1968 (Washington, D.C.: NASA, 1962–1968).

Table 6–68. Awards to Personnel Granted under Section 306 of the Space Act of 1958[a]

Year	Inventor	Contribution	Amount
1961	William J. O'Sullivan, Jr.	Erectible self-supporting space vehicle	$ 5 000
1962	Emedio M. Bracalente Ferdinand C. Woolson	Ablation rate meter	2 000
1963	Robert L. Trimpi	Expansion tube for hypervelocity	3 000
	Charles H. McLellan	Wedge tails for hypersonic aircraft	2 000
	Francis Rogallo with Mrs. F. Rogallo	Flexible wing (kite)	35 000
	William J. Alford, Jr. Edward C. Polhamus	Variable-sweep-wing configuration	2 000
	Thomas A. Toll	Variable-sweep-wing supersonic aircraft	600
	Robert V. Hess	Hall-current plasma accelerator	1 200
1966	John C. McFall, Jr. Ray W. Lovelady	Underwater location system	1 500
1967	Robert A. Jones James L. Hunt	Technique for quantitative measurement of aerodynamic heat transfer to supersonic wind-tunnel models of complicated shapes	2 600

[a] For complete listing of awards under this Act, see Appendix A, Sect. I.B.

Source: NASA, Inventions and Contributions Board.

LEWIS RESEARCH CENTER

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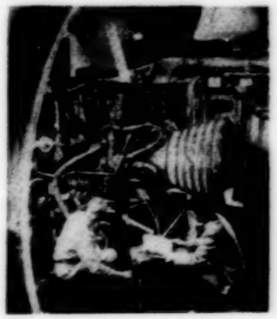
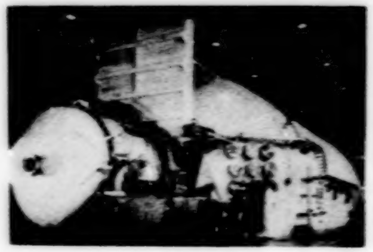
Lewis Research Center, Cleveland, Ohio (left), photographed in 1963. Among the Center's research projects have been the RL-10 high-energy liquid-hydrogen and liquid-oxygen engine for Centaur and Saturn launch vehicle stages (RL-10 at far left below, photographed in 1968 just before a test-firing in the altitude tank), ion engines for satellites and interplanetary spacecraft propulsion (a small-scale version second from left below, being installed in a low-pressure test facility), and reduction of jet aircraft noise (a turbojet engine third from left below, being prepared for a 1968 test run). LeRC's High Vacuum Facility (at right below) was used for testing ion engine research models.





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LEWIS RESEARCH CENTER (LeRC)

Location: Cleveland, Cuyahoga County, Ohio.

Land: 5368.4 total hectares (13 265.68 acres) as of June 30, 1968:

Cleveland: 141.3 hectares (349.19 acres) NASA-owned.
5.9 hectares (14.60 acres) leased.
147.2 hectares (363.79 acres).

Plum Brook: 2420.4 hectares (5980.79 acres) NASA-owned.
20.2 hectares (50.00 acres) easements.
2440.6 hectares (6030.79 acres).

Industrial: 2780.6 hectares (6871.1 acres) NASA-owned.

Director: Abe Silverstein (Nov. 1, 1961-).

Eugene J. Manganiello (January 1961-October 1961, Acting Director).

Edward R. Sharp (Director Emeritus, January 1961-†July 24, 1961; Director, NACA Lewis Flight Propulsion Laboratory, September 1948-September 1958; Director, NACA Aircraft Engine Research Laboratory, June 1947-September 1948; Manager, NACA Aircraft Engine Research Laboratory, May 1942-June 1947).

Deputy Director:

Eugene J. Manganiello (Dec. 13, 1961- ; Associate Director, Oct. 27, 1958-Dec.13, 1961; Assistant Director, 1952-1958; Assistant Chief of Research, Lewis Flight Propulsion Laboratory, 1949-1952; Chief, Thermodynamics Branch, LFPL, 1948-1949, and NACA Engine Research Laboratory 1945-1948).

Abe Silverstein (Associate Director, Lewis Flight Propulsion Laboratory, 1952-Sept. 30, 1958; Chief of Research, LFPL, 1949-1952; Chief, Wind Tunnel and Flight Division, LFPL, 1948-1949, and NACA Aircraft Engine Research Laboratory, 1943-1948).

History

Congress authorized a new flight propulsion laboratory June 26, 1940,[1] and in November, after surveying 72 locations in 62 cities, the National Advisory Committee for Aeronautics announced selection of the Cleveland site.[2] On January 23, 1941, ground was broken for the NACA Aircraft Engine Research Laboratory,[3] on 80.8 hectares (199.7 acres) adjacent to the Cleveland-Hopkins Municipal Airport.[4] The NACA renamed the installation Lewis Flight Propulsion Laboratory September 28, 1948, in honor of Dr. George W. Lewis (1882-1948), NACA Director of Aeronautical Research from 1919 to 1947. When NASA was established October 1, 1958, the laboratory became Lewis Research Center (LeRC).[5]

During World War II, Lewis research improved reciprocating aircraft engines, fuels, and superchargers and other engine components.[6] All facilities were converted after the war from gas-piston to turbojet research, and pioneer work was done on afterburners, combustion efficiency, and turbine and compressor efficiency.[7] Rocket test facilities were added in the 1950s,[8] and early Lewis studies demonstrated the feasibility of using high-energy fluorine and hydrogen instead of kerosene as a fuel.[9]

With the establishment of NASA, theoretical studies on ion propulsion and spacecraft power systems expanded to the hardware testing stage and new facilities were built to develop these systems; for example, by early 1961 Lewis had tested for the first time a laboratory-model mercury bombardment ion engine.[10]

NASA announced transfer of Centaur launch vehicle and M-1 engine project management from Marshall Space Flight Center to Lewis September

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[1] J. C. Hunsaker, "Forty Years," 262; *Twenty-sixth Annual Report of the NACA, 1940* (Washington, D.C.: GPO, 1941), 20-21. This section on history of Lewis Research Center was prepared for the *Data Book* by Lynn Manley and Hugh W. Harris of LeRC.

[2] John D. Holmfeld, "The Site Selection for the NACA Engine Research Laboratory: A Meeting of Science and Politics" (Master's essay, Case Institute of Technology, 1967), 108; Keller, "A Chronology," 49.

[3] LeRC Release 66-1.

[4] "Official Deed from the City of Cleveland to the United States of America," Nov. 27, 1940.

[5] Proclamation dated Sept. 25, 1958, signed by Administrator T. Keith Glennan, *Federal Register*, Sept. 30, 1958 (23 F.R. 7579), reprinted in NASA, *First Semiannual Report* (Washington, D.C.: GPO, 1959), Append. E , 66-67.

[6] Gray, *Frontiers of Flight*, Chaps. 11-13.

[7] NASA, *Budget Estimates*, FY 1969, IV, AO 2-83 through 2-86; Abe Silverstein, "Research on Aircraft Propulsion Systems," Twelfth Annual Wright Brothers Lecture, presented before the Institute of the Aeronautical Sciences, Washington, D.C., Dec. 17, 1948, published in *Journal of the Aeronautical Sciences*, XVI, No. 4 (April 1949), 197-222; *Thirty-eighth Annual Report of the NACA, 1951* (Washington, D.C.: GPO, 1954), 4-6.

[8] NASA, *Technical Facilities Catalog* (March 1967 ed.), I, Sec. 5, 15-16.

[9] NASA, *Budget Estimates*, *idem.*

[10] U.S. Congress, Senate, Committee on Aeronautical and Space Sciences, *NASA Scientific and Technical Programs, Hearings*, 87th Cong., 1st sess., Feb. 28, March 1, 1961 (Washington, D.C.: GPO, 1961), 385.

30, 1962,[11] and the Agena program with its associated Thor and Atlas boosters December 12, 1962.[12] Assignment of the 6.6-meter (260-inch) solid motor project to Lewis was announced September 10, 1964,[13] and management of the RL-10 engine project was transferred from Marshall to Lewis April 1, 1966.[14] In August 1966, NASA designated Lewis as the Center responsible for development of space vehicle design criteria in the area of chemical propulsion.[15]

Mission

Lewis Research Center was assigned responsibility for research and development in the areas of advanced propulsion and space power generation:

(1) Conducting basic and applied research on materials and metallurgy; cryogenic and liquid-metal heat-transfer fluids; pumps and turbines; combustion processes, propellants, tankage, injectors, chambers, and nozzles; system control dynamics; plasmas and magnetohydrodynamics; space meteoroid damage; and zero gravity effects;

(2) Maintaining technical management of NASA contracts on chemical and electric propulsion, air-breathing engines, nuclear and solar space power systems; and managing the Centaur and Agena launch vehicle projects.[16]

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[11] LeRC Release 62-209.

[12] NASA Release 62-261.

[13] NASA Release 64-231.

[14] NASA Release 66-74.

[15] LeRC Release 66-40.

[16] NASA, *Budget Estimates, idem.;* U.S. Congress, House, Committee on Science and Astronautics, Subcommittee on Advanced Research and Technology, *1969 NASA Authorization, Hearings,* Pt. 4, 90th Cong., 2d sess., Feb. 19-22, 26-29, 1968 (Washington, D.C.: GPO, 1968), 106 ff.

PLUM BROOK STATION

Location: Near Sandusky, Erie County, Ohio.

Land: 2420.4 hectares (5981 acres) NASA-owned as of June 30, 1968.
20.2 hectares (50 acres) non-Federal.

Director: Alan D. Johnson (April 29, 1962-).

History

After surveying 18 locations, NACA selected the site and leased 202.3 hectares (500 acres) from the U.S. Army in March 1956.[1] Plum Brook Ordnance Works, named for a small stream running through the property and draining into Lake Erie,[2] had been operated for the Army as a TNT manufacturing facility by Trojan Power Company from January 1942 until August 17, 1945.[3] Ground was broken for the Plum Brook Research Reactor Facility September 26, 1956; NACA planned to use the new facility for research in problems of aircraft nuclear propulsion systems.[4]

After construction was completed in 1961,[5] AEC issued a provisional operating license March 14[6] for the 60-megawatt reactor. On June 14, the reactor became operational and began running on low-power calibration[7] reaching full power for the first time April 21, 1963.[8] The first six experiments were begun July 17, 1963,[9] and the 50th cycle was completed August 12, 1966,[10] under a full-term, 10-year operating license granted by AEC April 12, 1965.[11] Transfer of the last parcel of U.S. Army land to NASA was completed March 15, 1963.[12] NASA's FY 1968 budget requested funds for purchase of an additional 1214.1 hectares (3000 acres) surrounding the site for establishment of a buffer zone and for a future entrance.[13]

Mission

The Plum Brook Station's mission was conducting (1) studies using the 60-megawatt reactor in experiments associated with development of nuclear rockets and components and systems for space nuclear propulsion and power; and (2) test programs for complete rocket engines and components with high-energy propellants.[14]

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[1] Lewis Flight Propulsion Laboratory Fact Sheet, Sept. 1956; LFPL Release, Sept. 26, 1956.

[2] LeRC Fact Sheet, Oct. 1, 1963.

[3] *Plum Brook News,* Aug. 18, 1945.

[4] LFPL Fact Sheet, September 1956; LFPL Release, Sept. 26, 1956.

[5] LeRC Fact Sheet, Oct. 1, 1963.

[6] AEC Release G-46, March 2, 1964.

[7] LeRC Release 61-133.

[8] LeRC Release 63-20.

[9] LeRC Release 63-57.

[10] LeRC Release 66-45.

[11] LeRC Release 65-27.

[12] LeRC Fact Sheet, Oct. 1, 1963.

[13] NASA, *Budget Estimates,* FY 1968, III, CF 6-7-10.

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[14] NASA, *Budget Estimates,* FY 1969, IV, AO 2-85, 2-86.

Table 6-69. Technical Facilities: Wind Tunnels
(with costs in thousands)

Facility Name	Year Built	Test Section Size in Meters (and feet)	Mach. No. Range	Reynolds No. Range	Init. Cost	Accum. Cost	Research Supported
Icing research tunnel	1944	1.8 x 2.7 x 6.1L (6 x 9 x 20L)	(300 mph)	–	$ 889.7	$ 956.9	Aerodynamics, operating problems, icing, flight safety, aircraft component design
8- by 6-foot supersonic research tunnel	1948–1949	2.4 x 1.8 x 11.9L (8 x 6 x 39L)	0.4 to 2.0	–	6 143	8 794	Propulsion, combustion, and aerodynamic studies of rocket boosters, aircraft
10- by 10-foot supersonic wind tunnel	1955	3.1 x 3.1 x 12.2 (10 x 10 x 40)	2 to 3.5 CV[a]	–	32 325	35 105	Propulsion, combustion, and aerodynamic studies of rocket boosters, aircraft

[a] Continuously variable.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), I, Sect. 5; Append. B.

Table 6-70. Technical Facilities Other Than Wind Tunnels
(with costs in thousands)

Functional Name	Facility Name	Year Built	Init. Cost	Accum. Cost	Research or Technological Area Supported
Engine research facility	Engine Research Building	1942–47	$ 9 033	$14 236	Testing compressors, turbines, compressor and turbine components, jet engines, combustion devices, and ion engine components
Environmental test facility	Space Power Chambers	1944	2 597	2 788	Space power systems, altitude control systems, vehicle separation tests, nosecone separation tests
Propulsion research facility, jet engine	Propulsion Systems Laboratory	1952	11 814	23 556	Investigation of full-scale turbojet or ramjet and rocket engines
Rocket propulsion test facility	Rocket Engine Test Facility	1956	2 397	2 438	Rocket cooling and combustion, performance and stability studies
Propulsion laboratory, electric	Electric Propulsion Laboratory	1961	5 014	5 024	Ion and plasma thrusters, spacecraft, and related components
Zero gravity facility	Zero Gravity Facility	1966	3 370	NA	Investigation of behavior of liquids and gases under weightless conditions

NA = Data not available. For definition of terms, see introduction to Chapter Two.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), I, Sect. 5.

Table 6-71. Technical Facilities: Plum Brook Station
(with costs in thousands)

Functional Name	Facility Name	Year Built	Init. Cost	Accum. Cost	Research or Technological Area Supported
Propellant research facility, cryogenic	Cryogenic Propellant Research Facility	1941	$ 263.7	$ 340.3	Pressurization, expulsion, and insulation of cryogenic propellant systems and tankage for space vehicles
Nuclear test reactor facility	Nuclear Test Reactor Facility	1959	14 536	15 867	Radiation effects on basic materials and components; basic physics experimental radiation effects pertinent to NERVA programs
Dynamics research facility	E Site Dynamics Research Facility	1960	1 094	1 094	Launch vehicle tests
Rocket propulsion test facility, altitude (B-1)	Altitude Rocket Test Facility (B-1)	1961	2 201	2 415	Test-firing under low-pressure exhaust conditions of small rockets using high-energy propellants
Nuclear rocket dynamics and control facility (B-3)	Nuclear Rocket Dynamics and Control Facility	1965	1 878	1 878	R&D of cryogenic turbopumps and their incorporation into vehicle propellant systems
Heat transfer facility	Heat Transfer Facility	1966	2 400	NA	Heat transfer
Nuclear propulsion environmental facility	Space Power Facility	1967	28 000	NA	Space nuclear power and propulsion systems; large nonnuclear vehicles, spacecraft, components

NA = Data not available. For definition of terms, see introduction to Chapter Two.

Source. NASA, *Technical Facilities Catalog* (March 1967 ed.), I, Sect. 5, 29-52.

Table 6-72. Industrial Real Property
(as of June 30; money amounts in thousands[a])

Category	General Dynamics Corporation under Contract NAS 3-3230 F							
	Combined Systems Test Stand San Diego, Calif.[b]		Point Loma Test Site Point Loma, Calif.[c]		Sycamore Canyon Test Area San Diego, Calif.[d]		Total	
	1967	1968	1967	1968	1967	1968	1967	1968
Land in hectares (and acres)	1.4 (3.5)	1.4 (3.5)	0	0	2994.6 (7399.65)	2779.2 (6867.6)	2996.0 (7403.15)	2780.6 (6871.1)
Buildings								
Number	1	1	8	8	22	14	31	23
Area in sq m (and sq ft)	2 680.3 (28 850)	2 680.3 (28 850)	550.3 (5 924)	550.3 (5 924)	6 789.7 (73 084)	5 726.4 (61 638)	10 020.3 (107 858)	8 957.0 (96 412)
Value								
Land	$ 21	$ 21	0	0	$ 357	$ 78	$ 378	$ 99
Buildings	858	858	$ 81	$ 81	1378	3289	2317	4228
Other structures and facilities	0	0	357	357	5325	3662	5682	4019
Total real property	$879	$879	$438	$438	$7060	$7029	$8377	$8346

[a] These figures are included in Table 6-73; data for earlier years are not available.

[b] Flight simulation facility was built in 1964 to aid evaluation of Atlas-Centaur Surveyor vehicle systems during the combined vehicle operation test simulating flight from launch to payload separation.

[c] Centaur test site land, about 12 hectares (30 acres), at US Navy Electronics Laboratory was made available to NASA by USN use permit NOy(R) 99497, April 8, 1966.

[d] The Centaur stand was activated in 1960 on a USAF missile test site. On June 10, 1964, USAF issued a use permit for 2316.8 hectares (5724.79 acres) of the Sycamore Canyon site; the land was transferred to NASA ownership effective June 24, 1966. NASA requested transfer of 677.9 additional hectares (1674.86 acres) Sept. 9, 1965; the land, in public domain, was placed under NASA control July 26, 1965, by Public Land Order 3749.

Source: NASA, Office of Facilities.

Table 6-73. Property
(as of June 30; money amounts in thousands)[a]

Category	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
Land in hectares (and acres)										
Owned	130.5 (322.4)	137.1 (338.8)[b]	140.6 (347.4)[c]	141.3 (349.2)[d]	2 561.7 (6 330.0)[e]	2 563.1 (6 333.5)[f]	2 563.1 (6 333.5)	5 557.5 (13 733.1)[g]	5 557.5 (13 733.1)	5 342.2 (13 201.0)
Leased	0	0	0	0	4 289.9 (10 600.7)[h]	5 730.7 (14 160.7)[i]	5 776.8 (14 274.7)[j]	6.1 (15.0)[k]	6.1 (15.0)	5.9 (14.6)
Buildings										
Number owned	34	40	40	40	318	367	131[l]	168	191	298
Area owned, thousands of sq m (and sq ft)	115.4 (1242)	141.6 (1524)	141.6 (1524)	141.6 (1524)	217.8 (2344)	259.2 (2790)	213.8 (2301)[l]	243.2 (2618)	264.1 (2843)	291.4 (3137)
Area leased, thousands of sq m (and sq ft)	0	0	0	1.5 (16)	3.6 (39)	0	0	0	0	0
Value										
Land	$ 184	$ 186	$ 189	$ 197	$ 1 582	$ 1 597[m]	$ 1 617	$ 1 618	$ 1 975	$ 1 696
Buildings	57 659	90 077	89 672	89 849	99 102	132 732	111 023[n]	150 573[n]	161 394	179 834
Other structures and facilities	6 072	11 462	11 477	11 587	21 227	21 093[n]	84 602[n]	45 043[n]	40 509	59 889
Real property	$63 915	$101 725	$101 338	$101 633	$121 911	$155 422	$197 242	$197 234	$203 878	$241 419
Capitalized equipment	NA	$ 12 479	$ 15 891	$ 21 691[o]	$ 26 836[p]	$ 30 867	$ 40 510	$ 77 361	$ 80 851	$ 96 884

[a] Includes Plum Brook and industrial facilities.

[b] 6.7 hectares (16.39 acres) acquired at Cleveland.

[c] 3.5 hectares (8.61 acres) acquired at Cleveland.

[d] 0.7 hectares (1.79 acres) acquired at Cleveland.

[e] 2420.4 hectares (5980.79 acres) at Plum Brook transferred from U.S. Army to NASA, March 15, 1963. Adjusted figure; 20.2 additional hectares (50 acres) in easements appeared in end-of-fiscal-year reports from FY 1963 through FY 1965.

[f] 1.4 hectares (3.5 acres) acquired for Combined Systems Test Facility (San Diego) in November 1963.

[g] 677.9 hectares (1674.86 acres) under public domain at Sycamore Canyon Test Area (San Diego) transferred to NASA control July 26, 1965; 2316.7 hectares (5724.79 acres) at Sycamore Canyon Test Area transferred from USAF to NASA effective June 24, 1966. Adjusted figure; industrial property was not included in end-of-fiscal-year reports.

[h] Includes 6.1 hectares (15 acres) leased from City of Cleveland (Jan. 11, 1963) and 4283.9 hectares (10 585.74 acres) leased from Aerojet-General Corp. at Nimbus, Calif., April 1, 1963.

[i] Additional 1440.7 hectares (3560 acres) leased for M-1 engine program at Nimbus, Calif., March 6, 1964.

[j] Additional 46.1 hectares (114 acres) leased at Nimbus, Calif., July 1964.

[k] Leases for land at Nimbus, Calif., terminated August 1965.

[l] Sharp decrease in owned buildings due to razing of unsafe pentalite manufacturing facilities left by Army Ordnance at Plum Brook.

[m] Adjusted figure; $1 476 000 appeared in end-of-fiscal-year reports.

[n] Adjustments in value of buildings and other structures and facilities due to reclassification.

[o] Adjusted figure; $21 000 000 appeared in end-of-fiscal-year reports.

[p] Adjusted figure; $21 691 000 appeared in end-of-fiscal-year reports.

NA = Data not available.

Source: NASA, Office of Facilities. Supplementary information was provided by Hugh W. Harris.

Table 6-74. Value of Real Property Components as Percentage of Total
(as of June 30; real property value in thousands)

Component	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
Land	0.3	0.2	0.2	0.2	1.3	1.0	0.8	0.8	0.9	0.7
Buildings	90.2	88.5	88.5	88.4	81.3	85.4	56.3	76.3	79.2	74.5
Other structures and facilities	9.5	11.3	11.3	11.4	17.4	13.6	42.9	22.9	19.9	24.8
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total LeRC real property value	$63 915	$101 725	$101 338	$101 633	$121 911	$155 422	$197 242	$197 234	$203 878	$241 419

Source: Derived from Tables 2-10 through 2-13 in Chapter Two.

Table 6-75. Personnel[a]

Employee Category	1958		1959		1960		1961		1962		1963	
	9/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31
Requested for FY ending	-		-		2828		2736		2824		4508	
Total, paid employees	2713	2696	2809	2749	2722	2743	2773	3036	3800	4118	4697	4760
Permanent	2703	2687	2802	2741	2703	2723	2751	3001	3721	4025	4577	4735
Temporary	10	9	7	8	19	20	22	35	79	93	120	25
Code group (permanent only)												
200[b]	211	213	219	211	208	201	46	46	47	64	33	29
700[c]	737	736	755	725	724	720	882	995	1384	1511	1816	1904
900	0	0	0	0	0	0	0	0	0	0	0	3
Subtotal	948	949	974	936	932	921	928	1041	1431	1575	1849	1936
600[d]	0	0	0	0	0	66	68	87	115	154	197	216
500	316	312	335	330	320	212	211	243	313	354	422	440
300	265	257	258	247	233	289	308	287	362	366	399	430
100	1174	1169	1235	1228	1218	1235	1236	1343	1500	1576	1710	1713
Subtotal	1755	1738	1828	1805	1771	1802	1823	1960	2290	2450	2728	2799
Excepted: on duty	7	29	33	32	28	27	26	27	32	35	35	36
Accessions: permanent	211	44	237	87	63	114	90	436	818	546	681	382
Accessions: temporary	21	1	59	3	33	14	113	71	218	136	274	54
Military detailees	25	28	30	23	12	11	12	12	15	29	39	42

Table 6–75. Personnel[a] (Continued)

Employee Category	1964		1965		1966		1967		1968
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Requested for FY ending	5128		4785		4815		4747		4676
Total, paid employees	4859	4878	4897	4834	5047	4825	4956	4623	4583
Permanent	4805	4806	4815	4778	4819	4756	4704	45[illegible]	4452
Temporary	54	72	82	56	228	69	252	40	131
Code group (permanent only)									
200[b]	28	30	30	29	27	25	22	21	19
700[c]	1929	1914	1924	1868	1892	1853	1868	1831	1791
900	3	3	4	5	5	5	4	4	4
Subtotal	1960	1947	1958	1902	1924	1883	1894	1856	1814
600[d]	234	241	254	243	245	244	240	230	219
500	448	469	472	467	498	488	470	448	426
300	417	394	390	408	377	370	361	348	358
100	1746	1755	1741	1758	1775	1771	1739	1701	1635
Subtotal	2845	2859	2857	2876	2895	2873	2810	2727	2638
Excepted: on duty	35	35	27	26	24	25	25	27	27
Accessions: permanent	261	198	158	183	269	196	132	NA	NA
Accessions: temporary	126	178	126	206	285	85	292	NA	NA
Military detailees	40	31	23	18	9	11	13	16	20

[a] Includes Plum Brook.

[b] Beginning June 30, 1961, the data reflect conversion of some professionals from the 200 Code group (engineers) to the 700 Code group (aerospace technologists). For key to Code group numbers and definition of terms, see Chapter Three.

[c] Data before June 30, 1961, are for "aeronautical research scientists." Beginning June 30, 1961, the data reflect conversion of these personnel members to the 700 Code group (aerospace technologists).

[d] Before Dec. 31, 1960, the data reflect inclusion of Code group 600 personnel in the 500 Code group.

NA = Data not available.

Source: NASA, Personnel Division. Data through Dec. 31, 1966, from NASA Quarterly Personnel Statistical Report; data after Dec. 31, 1966, from NASA Personnel Management Information System and the NASA Supplement to SF 113–A, "Monthly Report of Federal Civilian Employment Short Form."

Table 6-76. Personnel: Plum Brook

Category	1958		1959		1960		1961		1962		1963	
	9/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31
Total, paid employees	25	31	88	106	168	201	214	304	439	471	541	544
Permanent	25	31	88	106	168	201	214	304	424	459	525	543
Temporary	0	0	0	0	0	0	0	0	15	12	16	1

Category	1964		1965		1966		1967		1968
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Total, paid employees	564	567	567	561	588	594	633	560	63
Permanent	561	559	562	559	567	584	576	559	63
Temporary	3	8	5	2	21	10	57	1	0

Source: LeRC, Personnel Division

Table 6-77. Distribution of Permanent Personnel Positions by Fiscal Year and Budget Activity[a]

Program	1959[b]	1960[b]	1961	1962	1963	1964	1965	1966	1967	1968
Manned space flight			5	0	34	45	24	11	1	0
(% of total)	(0.0)	(0.0)	(0.2)	(0.0)	(0.8)	(0.9)	(0.5)	(0.2)	(0.1)	(0.0)
Space applications			0	0	0	0	0	0	25	82
(% of total)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.5)	(1.8)
Unmanned investigations in space			5	0	404	422	364	377	342	239
(% of total)	(0.0)	(3.0)	(0.2)	(0.0)	(8.8)	(8.7)	(7.6)	(7.8)	(7.3)	(5.4)
Space research and technology			2391	3519	2254	2025	2642	2423	2078	1854
(% of total)	(40.0)	(55.0)	(86.7)	(95.5)	(49.3)	(41.8)	(54.8)	(50.3)	(44.4)	(41.6)
Aircraft technology[c]			355	159	61	69	85	276	541	716
(% of total)	(60.0)	(42.0)	(12.9)	(4.3)	(1.3)	(1.4)	(1.8)	(5.7)	(11.6)	(16.1)
Supporting activities[d]			0	8	1819	2290	1700	1732	1689	1561
(% of total)	(0.0)	(0.0)	(0.0)	(0.2)	(39.8)	(47.2)	(35.3)	(36.0)	(36.1)	(35.1)
Total			2756	3686	4572	4851	4815	4819	4676	4452

[a] Based on number of actual positions reported in annual NASA Budget Estimates. FY 1961 actual figure was reported in NASA, *Budget Estimates, FY 1963;* FY 1962 actual figure was reported in NASA, *Budget Estimates, FY 1964*, etc.

[b] Actual positions data are not available for FY 1959 and FY 1960. Percentages in these two columns are based on distribution used by NASA Office of Programming, Budget Operations Division, in preparing *History of Budget Plans, Actual Obligations, and Actual Expenditures for Fiscal Years 1959 through 1963* (Washington: NASA, 1965), Sect. 8.

[c] FY 1961 figure represents "aircraft and missile technology."

[d] FY 1963 and later figures include tracking and data acquisition, technology utilization, and general support positions. Until FY 1963 support positions were reported with the five other budget activities. FY 1962 figure represents technology utilization (reported as "industrial applications").

Source: NASA, *Budget Estimates*, FY 1963–FY 1969; NASA, Budget Operations Division.

Table 6–78. Funding by Fiscal Year
(program plan as of May 31, 1968, in millions)

Appropriation Title	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total
Research and development	$ 3.40	$ 7.00	$12.70	$ 62.00	$247.30	$299.90	$323.20	$249.90	$162.60	$131.30	$1499.30
Construction of facilities[a]	8.02	6.62	9.59	1.04	44.81	20.41	.77	.87	16.00	2.12	110.25
Administrative operations[b]	27.77	31.23	35.85	45.24	53.59	61.50	69.33	66.39	66.28	66.22	523.40
Total	$39.19	$44.85	$58.14	$108.28	$345.70	$381.81	$393.30	$317.16	$244.88	$199.64	$2132.95

[a] Does not include facilities planning and design.

[b] FY 1959–1962 appropriations were for salaries and expenses; FY 1963 appropriation was for research, development, and operation.

Sources: NASA, Office of Programming, Budget Operations Division, *History of Budget Plans, Actual Obligations, and Actual Expenditures for Fiscal Years 1959 Through 1963* (Washington, D.C.: NASA, February 1965); NASA, Budget Operations Division, "Status of Approved Programs," FY 1959–FY 1968, May 1968.

Table 6–79. Actual Obligations for Construction of Facilities by Fiscal Year and Program Year
(in millions)

Program Year	Program Plan[a]	FY 1959	FY 1960	FY 1961	FY 1962	FY 1963	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	Total
1959	$ 8.0	$3.1	$3.3	$ 0.8	$0.7	*	*	0	0	0	0	$ 8.0
1960	6.6		2.7	2.6	0.7	$ 0.5	$ 0.2	*	0	0	0	6.6
1961	9.6			6.7	2.0	0.7	0.2	–*	*	0	0	9.6
1962	1.8				1.7	*	*	*	*	0	0	1.8
1963	45.8					9.6	23.3	$ 8.3	$1.7	$0.3	$1.1	44.3
1964	20.4						2.7	10.2	4.6	1.7	0.7	20.0
1965	1.7							*	1.4	0.1	0.2	1.8
1966	1.3								0.4	0.5	*	0.9
1967	16.0									4.5	1.6	6.1
1968	2.1										0	0
Total	$113.3	$3.1	$5.9	$10.0	$5.1	$10.9	$26.5	$18.6	$8.2	$7.1	$3.7	$99.2

[a] As of June 30, 1968; includes facilities planning and design.

* = Less than $100 000. Because of rounding, columns and rows may not add to totals.

Source: NASA, Budget Operations Division, "Status of Approved Programs, Construction of Facilities," FY 1959–FY 1968, June 1968; NASA Financial Management Division, "Summary Financial Status of Programs," June 30, 1968.

Table 6–80. Total Procurement Activity by Fiscal Year
(money amounts in millions)

	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total
Net value of contract awards	$17.2	$24.0	$34.5	$214.7	$347.4	$324.2	$262.0	$214.8	$152.9	$1591.7
Percentage of NASA total	5%	3%	2%	7%	8%	6%	5%	4.6%	3.7%	5.4%

Source: NASA, Procurement and Supply Division, *NASA Procurement: October 1, 1958 to June 30, 1960* (Washington, D.C.: NASA, September 1960); NASA, *Annual Procurement Report*, Fiscal Years 1961–1968 (Washington, D.C.: NASA, 1962–1968).

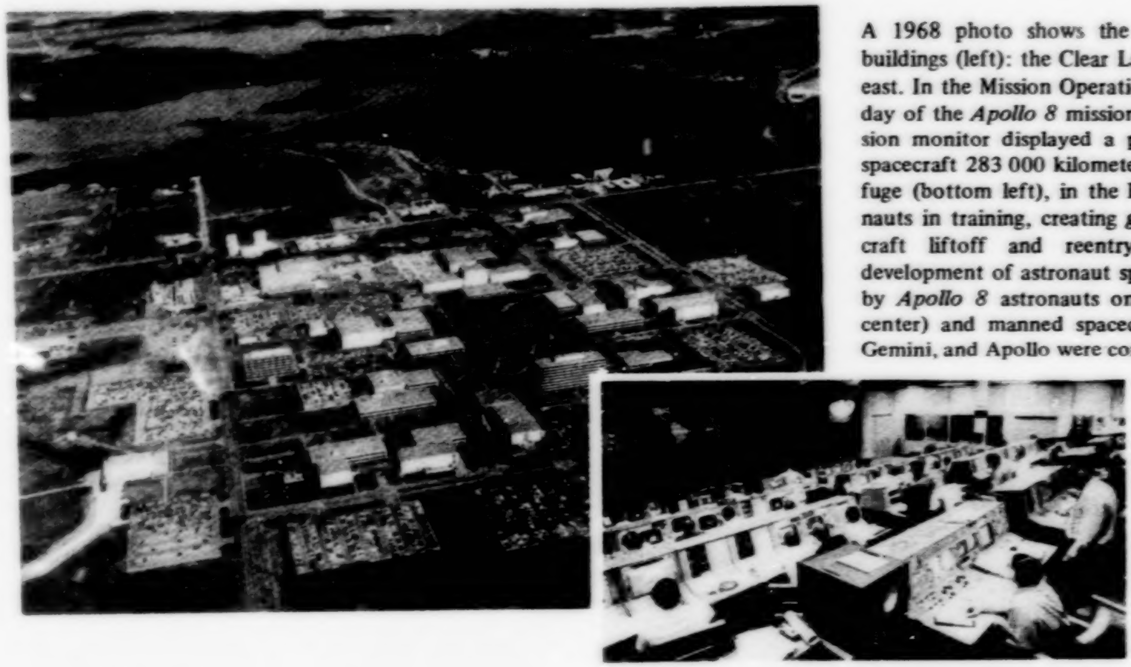
Table 6–81. Awards to Personnel Granted under Section 306
of the Space Act of 1958[a]

Year	Inventor	Contribution	Amount
1963	Harold R. Kaufman	Ion rocket	$4000
1964	William R. Cherry, (GSFC) with Joseph Mandelkorn, (LeRC)	Solar cell for radiation environment	6000

[a] For complete listing of awards under this Act, see Appendix B, Sect. 1.B.

Source: NASA, Inventions and Contributions Board.

MANNED SPACECRAFT CENTER



A 1968 photo shows the Manned Spacecraft Center's principal buildings (left): the Clear Lake site, Houston, Texas, looking northeast. In the Mission Operations Control Room (below) on the third day of the *Apollo 8* mission to the moon, Dec. 23, 1968, the television monitor displayed a picture of the earth telecast from the spacecraft 283 000 kilometers (176 000 miles) away. MSC's centrifuge (bottom left), in the Flight Acceleration Facility, spun astronauts in training, creating *g*-forces to be met during Apollo spacecraft liftoff and reentry. MSC responsibility also included development of astronaut spacesuits and life-support systems (worn by *Apollo 8* astronauts on the way to the launch pad, bottom center) and manned spacecraft (command modules for Mercury, Gemini, and Apollo were compared by an artist, bottom right).

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MANNED SPACECRAFT CENTER (MSC)

Location: Houston, Harris County, Texas.

Land: 723.4 total hectares (1787.5 acres) as of June 30, 1968:
- – 655.6 hectares (1620 acres) NASA-owned.
- – 0.7 hectares (1.6 acres) leased.
- – 67.1 hectares (165.9 acres) NASA-owned, Downey, California.

Director: Robert R. Gilruth (November 1961- ; Director, Space Task Group [STG], January 1961-November 1961; Assistant Director, Manned Satellites, GSFC, and Director, Project Mercury, STG, May 1959-January 1961; Assistant Director, Beltsville Space Center, and Director, Project Mercury, STG, February 1959-May 1959; Assistant Director, Langley Research Center, and Project Manager, Manned Satellite Program [named Project Mercury November 1958], STG, October 1958-February 1959).

Deputy Director:

George S. Trimble (October 1967-).

George M. Low (February 1964-April 1967).

James C. Elms (November 1963-February 1964; Deputy Director for Development and Programs, February 1963-November 1963).

Walter C. Williams (Deputy Director for Mission Requirements and Flight Operations, February 1963-November 1963; Associate Director, MSC, November 1961-February 1963; Associate Director, STG, April 1961-November 1961; Associate Director [Operations], STG, January 1961-April 1961; Associate Director [Operations], Project Mercury, STG, GSFC, September 1959-January 1961).

Charles J. Donlan (Associate Director [Development], STG, January 1961-April 1961; Associate Director [Development], STG, GSFC, September 1959-January 1961; Assistant Director, Project Mercury, STG, GSFC, May 1959-September 1959; Assistant Director, Project Mercury, STG, Beltsville Space Center, February 1959-May 1959; Assistant Project Manager, Manned Satellite Program [named Project Mercury November 1958], October 1958-February 1959).

History

In October 1958, NASA Administrator T. Keith Glennan approved a manned satellite plan (later named Project Mercury) to be carried out by a team led by Robert R. Gilruth at the Langley Research Center. A month later Glennan formalized his action and the team of 35 persons became the Space Task Group (STG), reporting directly to NASA Headquarters. This arrangement was only temporary, as NASA already had decided to locate the operational aspects of manned and unmanned space flight programs at a new center to be established in Beltsville, Maryland.[1] In February 1959, before any construction had begun, NASA established the Beltsville Space Center (redesignated Goddard Space Flight Center in May), although most of its assigned activities, such as Space Task Group, were physically elsewhere.[2]

The importance of Project Mercury in the national space program, plus imminent approval of follow-on and more difficult manned space flight efforts such as Project Apollo, caused NASA to establish Space Task Group as a separate field installation in January 1961, although it was still at Langley.[3] Approval by Congress of President John F. Kennedy's decision to make Apollo a lunar-landing goal in the 1960s warranted the selection and construction of a new facility to carry out these responsibilities. In August 1961 a NASA survey team visited 20 cities, judging each on 10 criteria. After receiving the team's recommendations, NASA Administrator James E. Webb announced September 19, 1961, that Houston, Texas, had been chosen as the site for a manned spacecraft center.[4]

Work in progress on Mercury and Apollo, plus the formulation of a third program later named Gemini, changed the character of Space Task Group from that of a single-task effort–Mercury–to a multiple-program effort, causing Space Task Group to be redesignated Manned Spacecraft Center (MSC) in November 1961.[5] Design began the following month for the new Center, which was to be in the Clear Lake vicinity, 32 kilometers (20 miles) southeast of Houston. In April 1962 permanent facility construction began on a 656-hectare (1620-acre) plot–413 hectares (1020 acres) donated by Rice University and 243 hectares (600 acres) purchased by NASA.[6]

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[1] Swenson, Grimwood, and Alexander, *This New Ocean*, 109-116. The *Data Book* section on history of MSC was prepared by James M. Grimwood, Manned Spacecraft Center.

[2] Rosenthal, *Venture into Space*, Append. D., Exhibits 7-12.

[3] Rosholt, *Administrative History of NASA;* NASA Historical Staff, *Historical Sketch of NASA* (Washington, D.C.: NASA EP-129, 1965), 31-32.

[4] James M. Grimwood, *Project Mercury: A Chronology* (Washington, D.C.: NASA SP-4001, 1963), 141, 147, 149; NASA Release 61-207; Swenson, Grimwood, and Alexander, *This New Ocean*, 390-392.

[5] Swenson, Grimwood, and Alexander, *This New Ocean*, 392.

Meanwhile, Manned Spacecraft Center personnel, now more than 1100 strong, began relocation from Langley to a number of temporary sites in Houston and into surplus buildings at Ellington Air Force Base. In this same period, Project Mercury achieved its objective–orbital flight of John H. Glenn, Jr.–and to prevent disruption of the operational momentum the Mercury staff remained at Langley through Mercury-Atlas 7 (*Aurora* 7, M. Scott Carpenter, May 24, 1962). By July 1962, all Manned Spacecraft Center activities had completed relocation.[7]

Contracts covering the development and manufacture of the Apollo and Gemini spacecraft were let in November and December.[8] To direct and carry out the three manned space flight programs then in progress, personnel strength of the Center grew significantly. By the end of 1962 the complement reached about 2400[9] and in June 1963, when Project Mercury came to a successful end,[10] the strength had risen by an additional thousand.[11] Movement from temporary sites to the Clear Lake facility, the first permanent home of the Manned Spacecraft Center and its predecessor, began in September 1963, with the major occupancy of the buildings occurring in February 1964.[12]

Flight tests of the Gemini and Apollo programs began in April and May 1964, with the unmanned launches of *Gemini-Titan 1* at Cape Kennedy and a Little Joe II-boosted, high-speed-abort test of a model of the Apollo command module at White Sands Missile Range Operations (later designated White Sands Test Facility).[13] Three other Apollo flight tests occurred within the year–two Saturn I launches at Cape Kennedy and a second Little Joe II launch at White Sands–but it was January 1965 before the second unmanned Gemini flight was accomplished.[14] However, 1965 might be characterized as

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[6] U.S. Congress, House, Committee on Science and Astronautics, *Master Planning of NASA Installations*, House Rpt. No. 167, 89th Cong., 1st sess., March 15, 1965 (Washington, D.C.: GPO, 1965), 11; MSC Brochure [Ivan D. Ertel], *Manned Spacecraft Center* (Houston: MSC, 1964), 10; Swenson, Grimwood, and Alexander, *This New Ocean*, 390, n. 20; NASA Administrator's Briefing Memorandum, Feb. 7, 1962; Letter, James E. Webb, NASA Administrator, to George E. Brown, Chairman of the Board of Trustees, William Marsh Rice Univ., Feb. 23, 1962.

[7] Swenson, Grimwood, and Alexander, *This New Ocean*, 392, 587, 642.

[8] U.S. Congress, House, Committee on Science and Astronautics, Report of the National Aeronautics and Space Administration to the Committee, *Aeronautical and Astronautical Events of 1961*, 87th Cong., 2d sess., June 7, 1962 (Washington, D.C.: GPO, 1962), 68, 71.

[9] Swenson, Grimwood, and Alexander, *This New Ocean*, 642.

[10] Grimwood, *Project Mercury*, 193, 196.

[11] Swenson, Grimwood, and Alexander, *This New Ocean*, 642.

[12] *Manned Spacecraft Center*, 10.

[13] MSC Fact Sheet No. 291 [Ivan D. Ertel], "Gemini Program," 4; MSC Fact Sheet No. 292 [Ivan D. Ertel], "Apollo Program," 3.

[14] James M. Grimwood, Barton E. Hacker, and Peter J. Vorzimmer, *Project Gemini: Technology and Operations–A Chronology* (Washington, D.C.: NASA SP-4002, 1969), 179.

"the year of the Gemini"; five manned Gemini flights recorded many significant space flight achievements–orbital path modification, long-duration missions, extravehicular activity, and rendezvous, to list a few.[15] Four Apollo test flights, launched from White Sands and Cape Kennedy, also were made in 1965.[16]

Project Gemini, the second manned space flight program, came to a successful conclusion with its 12th flight in November 1966. The 10 manned flights of this program had spanned only 20 months.[17] Apollo, too, experienced an active test flight year in 1966. The Little Joe II phase concluded with a successful launch in January, and three Saturn IB flights–AS-201, AS-202, and AS-203–were launched from Cape Kennedy. Because of test results, NASA decided in October to man the Apollo-Saturn 204 mission.[18] On January 27, 1967, the program received a major setback. During a launch-pad test, a fire in the Apollo command module resulted in the deaths of the three flight crew members.[19]

After 16 months of investigation and redesign, the Apollo mission was actively resumed with the unmanned test flights of *Apollo 4, 5,* and *6.* Test results verified that the Saturn V vehicle and its payload were ready for manned flight. The October 11, 1968, manned earth orbital flight of *Apollo 7* demonstrated the viability of the command and service modules[20] and was followed by the December 21, 1968, manned lunar orbital flight of *Apollo 8*–which made its historic flight beyond earth's gravity to complete 10 orbits of the moon and returned its crew successfully to earth.[21]

Mission

Manned Spacecraft Center was assigned responsibility for design, development, and manufacture of manned spacecraft, selection and training of astronaut crews, and conduct of space flight missions; project management of the Mercury, Gemini, and Apollo programs; and program planning and technical analysis of the Apollo Applications program and other post-Apollo activities. Responsibility in 1968 specifically included:

(1) Design, development, and fabrication of Apollo spacecraft, including the command, service, and lunar modules; contractor management;

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[15] *Ibid.*, Append. 1, Table A-D; Append. 2.

[16] *Astronautics and Aeronautics, 1965* (Washington, D.C.: NASA SP-4006, 1966), 570.

[17] For flight summary data, see: Grimwood, Hacker, and Vorzimmer, *Project Gemini,* Append. 1, Table A.

[18] *Astronautics and Aeronautics, 1966* (Washington, D.C.: NASA SP-4007, 1967), 332.

[19] U.S. Congress, House, Committee on Science and Astronautics, *Investigation Into Apollo 204 Accident*, Vols. I and II. Hearings 90th Cong., 1st sess., April 10-12, 17, 21, May 10, 1967 (Washington, D.C.: GPO, 1967).

[20] *Astronautics and Aeronautics, 1968* (Washington, D.C.: NASA SP-4010, 1969), 250-253.

[21] *Ibid.*, 318-322.

(2) Overall program management and control of the spacecraft, including module integration, tests, and qualification;

(3) Testing and evaluation of flight hardware;

(4) Selection and training of astronauts and preparation of crews for each mission;

(5) Operation of Mission Control Center and control of space flight missions (including recovery);

(6) Development of scientific experiments to be flown on manned space flight missions;

(7) Medical research and operation.[22]

Ellington Air Force Base Buildings

Location: Ellington Air Force Base, Texas.

Area: 44 033 square meters (473 964 square feet) of floor space (use and occupancy agreement with the Department of the Air Force under AF Permit No. DA-41-443-ENG 7909, Jan. 14, 1965; Permit No. DACA-63-4-68-0087, Aug. 7, 1967).

History

In October 1961 Space Task Group began moving into leased office space in Houston. By the middle of 1962, Manned Spacecraft Center activities were scattered in 11 different locations—in 10 commercial office buildings and at Ellington AFB facilities, which housed Procurement, Financial Management, and Photographic Services and Supply Divisions. In 1968 Manned Spacecraft Center's Aircraft Operations Office, some sections of the Personnel, Resources Management, Technical Services, and other divisions, as well as the NASA Regional Audit Office, still occupied space at Ellington.[23]

Berth for Range Operations Ship

Location: Seabrook Shipyard, Seabrook, Texas.

Area: 1394 square meters (15 000 square feet) of dock area (rented at $260.50 per month under Contract No. NAS 9-6977, dated March 31, 1967).

History

The NASA Motor Vessel *Retriever* was built by the Army in 1954 as a resident offices from Manned Spacecraft Center and Marshall Space Flight Center, also established at Downey in May 1962.[1]

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[22] NASA, *Budget Estimates*, FY 1969, IV, AO 2-12.

[23] Swenson, Grimwood, and Alexander, *This New Ocean*, Chap. XII, 392, n. 23, 587.

The Space and Information Systems Division was under Air Force contract in May 1962, and the 8000 company employees were working on the GAM-77 (Hound Dog) project. The Air Force accepted the NASA decision to establish an office at Downey and began a phasedown of the Air Force staff. The Air Force was phased out of the Downey location in October in 1964, at which time full responsibility for quality assurance, contract administration, facilities administration, and system review and approval was placed on NASA-O.

The personnel complement for Space and Information Systems Division reached 35 500 at peak employment on the NASA contracts. The NASA-O complement reached a high of 198 in 1966 before reductions to follow a decreasing workload.

On June 16, 1966, the reporting relationship of NASA-O was changed; NASA-O thenceforth reported directly to the NASA Headquarters Assistant Administrator for Industry Affairs instead of to the Director of the Western Operations Office.[2]

The Office was disestablished April 9, 1967, and its functions were transferred to Manned Spacecraft Center and Marshall Space Flight Center.[3]

Table 6-150. **Personnel: NASA Office–Downey**

Employee Category	12/31/66
Total paid employees	127
Permanent	125
Temporary	2

Source: NASA, Personnel Division.

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[1] NASA General Management Instruction 2-2-16.1, May 11, 1962; NASA Release 62-115; Rosholt, *An Administrative History*, 253-254; "NASA-O/Downey Development Plan 1967," 1-6. The *Data Book* section on history of the Downey Office was prepared by John R. Biggs, NASA Executive Secretary.

[2] NASA Management Instruction 1136.28, June 16, 1966.

[3] NASA Notice 1136, April 9, 1967.

C-6

NORTH EASTERN OFFICE
(NEO)

Location: Cambridge, Middlesex County, Massachusetts.

Director: Franklyn W. Phillips (Aug. 14, 1962-Sept. 1, 1964).

History

On July 3, 1962, NASA announced that it would establish an office to serve as technical and administrative liaison with contractors, research institutions, and other Government agencies in the Northeast area of the United States. The NASA North Eastern Office was established August 14, 1962, and along with liaison functions, it was assigned responsibility for providing technical, scientific, and administrative support as requested by other NASA components in the execution of their operations in the Northeast.[1]

With the establishment of the Electronics Research Center September 1, 1964, the Director of the North Eastern Office was appointed Assistant Director for Administration of Electronics Research Center. Personnel of the NASA North Eastern Office, with personnel from the Electronics Research Task Group, NASA Headquarters Office of Advanced Research and Technology, formed the initial complement of the new Center.[2]

The North Eastern Office was formally disestablished September 1, 1965.[3]

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[1] NASA Circular 250 (Ref. 2-2-17), Aug. 14, 1962; NASA Releases 62-155, 62-175. The *Data Book* section on history of the North Eastern Office was prepared by Patricia Shea, Electronics Research Center.

[2] NASA Circular 320 (Ref. 2-2-17), Sept. 1, 1964; NASA Releases 64-218, 64-219.

[3] NASA Notice 1148, Sept. 1, 1965.

PACIFIC LAUNCH OPERATIONS OFFICE (PLOO)

Location: Lompoc, Santa Barbara County, California.

Director: William H. Evans (May 21, 1962-Oct. 1, 1965).
Cdr. Simon J. Burttschell (USN) (Acting Director, March 7, 1962-May 21, 1962; Chief, NASA Test Support Office, Naval Missile Facility, Point Arguello, Feb. 28, 1961-May 21, 1962; Director, NASA Test Support Office, PMR, Point Mugu, Nov. 17, 1960-Feb. 28, 1961).

History

Early launch operations on the California coast centered on two geographical locations–Point Mugu, near Oxnard, California, and Point Arguello, near Lompoc, about 200 kilometers (125 miles) north. In January 1946 the first missile was launched at the Point Mugu Naval Air Facility, and on October 1, 1946, the Naval Air Missile Test Center (NAMTC) was established at Point Mugu to provide an instrumented range for testing air-launched and small surface-launched missiles.[1]

The Department of Defense announced January 29, 1958, plans to establish the Pacific Missile Range (PMR) with headquarters at the Naval Missile Center (formerly NAMTC), Point Mugu, and PMR was officially established on June 16, 1958, under Navy management to provide range support for Department of Defense and other Government space programs. The Naval Missile Facility, Point Arguello, was set up April 15, 1958, as the ballistic missile testing portion of PMR, and the first missile–a Nike-Asp–was launched there July 29, 1959.[2]

Point Arguello was on the 7689-hectare (19 000-acre) southern portion of a 34 803-hectare (86 000-acre) tract that had been Camp Cooke, an Army base opened by the Department of War October 5, 1941, closed early in 1946, reopened August 3, 1950, for training of the 40th Infantry Division and other units for Korea, and then closed again February 1, 1953. The northern, 25 900-hectare (64 000-acre) segment of Camp Cooke was transferred to the Air Force November 16, 1956, for an ICBM crew training base. Cooke Air Force Base was opened June 7, 1957, by the USAF Air Research and Development Command's (ARDC) Air Force Ballistic Missile Division. The Strategic Air Command (SAC) acquired the base January 1, 1958, and renamed it in honor of the late Gen. Hoyt S. Vandenberg October 4, 1958. On December 16 that year the first successful missile, a USAF Thor, was fired from Vandenberg Air Force Base, inaugurating the IRBM portion of the Pacific Missile Range.[3]

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[1] Emme, *Aeronautics and Astronautics, 1915-1960,* 53, 55. The *Data Book* section on history of PLOO was prepared from information provided by Simon J. Burttschell and William H. Evans of Pacific Launch Operations Center, with additional material provided by Roll D. Ginter, NASA Special Programs Office Director.

[2] Emme, *Aeronautics and Astronautics, 1915-1960,* 99, 11.

In the early 1960s the Pacific Missile Range consisted of (1) a Sea Test Range off the central California coast for testing relatively small air- and surface-launched missiles, (2) an IRBM range extending from Vandenberg to an impact area halfway between California and Hawaii, (3) an ICBM range from Vandenberg and Point Arguello to impact areas in the Marshall Islands, (4) an anti-ICBM range based on Kwajalein Atoll, and (5) a Polar Orbit Range, straight south from Vandenberg and Arguello. Land installations under PMR command included—in addition to the Naval Missile and Astronautics Center, Point Mugu, and Naval Missile Facility, Point Arguello—Kwajalein and Eniwetok Atolls in the Marshall Islands; San Nicolas Island, California; five Hawaii locations; Wake, Midway, and Canton Islands; and small coastal stations at Point Sur and Point Pillar and on San Clemente, Anacapa, Santa Cruz, Santa Rosa, and San Miguel Islands, California.[4]

From NASA's establishment October 1, 1958, through mid-1960, its launch operations were conducted at Cape Canaveral, Florida. NASA maintained a small liaison office there—the Atlantic Missile Range Operations Office (AMROO)—which was terminated June 30, 1960, with the establishment of the Launch Operations Directorate (LOD) as part of the Marshall Space Flight Center (MSFC).[5] Effective July 1, 1960, field responsibilities for NASA launchings at both the Atlantic Missile Range and the Pacific Missile Range were assigned to the Launch Operations Directorate.[6]

The first NASA launch at the Pacific Missile Range—a NERV (nuclear emulsion recovery vehicle) experiment—was September 19, 1960,[7] and shortly afterward, on October 27, NASA established the NASA Test Support Office at PMR under Launch Operations Directorate jurisdiction. On February 28, 1961, the NASA Test Support Office was transferred to the Naval Missile Facility, Point Arguello. Pacific Missile Range launches were expected to be conducted by contractors, and the six-man NASA office was to act as liaison with PMR. To carry out his assignment, the Director of the NASA Test Support Office, Point Mugu (later Chief, NASA Test Support Office, Point Arguello), traveled back and forth, spending two days a week in his liaison role at PMR Headquarters on Point Mugu and then three days supervising operations at Naval Missile Facility, Point Arguello.[8]

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[3] *Ibid.*, 83, 104; Vandenberg Air Force Base, *Fact Sheet*, n.d. A Federal correctional institution occupied 1200 hectares (3000 acres) of former Camp Cooke.

[4] Russel Hawkes, "Missile Defense Dominates PMR Efforts," *Aviation Week* (April 17, 1961), 69-85.

[5] Jarrett and Lindemann, "Historical Origins of NASA's Launch Operations Center," 54.

[6] NASA Announcement No. 156, June 13, 1960, Subject: Organizational Changes at AMR and PMR; NASA, *Fourth Semiannual Report* (Washington, D.C.: GPO, 1961), 84-85.

[7] NASA, *Fourth Semiannual Report*, 37-40.

[8] Memorandum, Chief, MSFC Liaison Branch, to Cdr. Simon J. Burttschell (USN), Oct. 26, 1960; NASA Release 60-300; NASA, *Fifth Semiannual Report* (Washington, D.C.: NASA, 1962), 153; Memorandum, Commander, PMR, to Cdr. Simon J. Burttschell, Jr. (USNR), Subject: Change of Duty; telephone interview with Simon J. Burtschell, Dec. 21, 1967.

NASA launch activity on the West Coast included principally satellites requiring polar orbit; the first launched from PMR was the Canadian satellite *Alouette 1* September 28, 1962. *Alouette 1* was NASA's first satellite in polar orbit, and its launch marked the first NASA use of the Thor-Agena B launch vehicle used by the U.S. Air Force at Vandenberg in the Discoverer satellite series. Personnel members from Goddard Space Flight Center were stationed at the Pacific Missile Range in February 1962 to supervise Goddard's Agena-launched missions, and in January 1963, responsibility for Thor-Agena launch operations was transferred from Marshall Space Flight Center to Goddard.[9]

In 1961 NASA began construction of a Scout launch facility on Naval Missile Facility property at Point Arguello. The facility became operational in April 1962 with the attempted launch of a Department of Defense satellite. The first NASA satellite launched by a Scout vehicle from the Pacific Missile Range was *Explorer 19* December 19, 1963. NASA's first dual payload was launched from the facility November 21, 1964, when a Scout vehicle orbited *Explorer 24* and *25*. Through 1968, the U.S. Air Force had successfully launched 11 satellites for NASA from this facility, which was later designated Western Test Range Launch Complex 5 (SLC-5). These launches included seven Explorer-class satellites and the international satellites *FR 1A*, *Ariel 3*, *ESRO 2B* (IRIS), and *Aurorae*. Launch vehicles for these missions were under the technical direction of a Langley Research Center Mission Support Office.

NASA acquired a USAF Thor-Agena launch pad (SLC-2E) in late 1961. This pad was modified in 1966 to accommodate the NASA Delta vehicle. The NASA satellites launched from this facility by mid-1968 were *Alouette 1* and *2*; *Echo 2*; *Nimbus 1* and *2*; *OGO 2* and *4*; *Pageos 1*; *GEOS 2*; *ESSA 3*, *4*, *5*, and *6*; and *Explorer 34* (IMP-F) and *38* (RAE-A).

On March 7, 1962, the Launch Operations Directorate was reorganized, with Marshall Space Flight Center retaining one segment designated the "Launch Vehicle Operations Division." The other two segments became independent NASA field installations; the Cape Canaveral facility was designated NASA Launch Operations Center (LOC), and the NASA Test Support Office at Point Arguello was redesignated Pacific Launch Operations Office (PLOO). The Director of Pacific Launch Operations Office reported to the Director of NASA Headquarters Office of Space Sciences, and was responsible for representing NASA in its relations with the Pacific Missile Range, negotiating and coordinating use of range services and facilities, providing administrative logistic and technical support for NASA programs and projects at PMR, coordinating requirements of other field installations at PMR, and executing various support functions.[10]

Major changes in U.S. range command initiated in 1963 affected NASA's relations with the West Coast ranges. In November 1963 Secretary of Defense

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[9] NASA Release 62-40; NASA, *Eighth Semiannual Report* (Washington, D.C.: NASA, 1963), 142; Memorandum, John J. Neilon, Deputy Director, KSC Unmanned Launch Operations, to Alfred Rosenthal, GSFC Historian, Jan. 23, 1968, Subject: Goddard Launch Team at PMR/WTR.

[10] NASA Circular No. 208, March 7, 1962; NASA Release 62-53; NASA General Management Instruction 2-2-15, Nov. 26, 1962.

Robert S. McNamara directed consolidation of Department of Defense ICBM and satellite test range facilities under one authority in the U.S. Air Force. The directive included transfer of Naval Missile Facility, Point Arguello, to Vandenberg AFB; assignment to the Air Force of responsibility for on-orbit control of spacecraft, except for Navy navigation satellites and military communications satellites; transfer from the U.S. Navy to the U.S. Army of the antimissile test support facilities at Kwajalein Atoll; and transfer from the Navy to the Air Force of Pacific space tracking stations.[11]

In compliance with this order, on January 2, 1964, the Air Force Systems Command (AFSC)–which had replaced the Air Research and Development Command April 1, 1961–established the National Range Division (NRD) Provisional Headquarters at Patrick AFB (Florida). At the same time the Air Force Space Test Center, Provisional, was established at Vandenberg AFB.[12] On May 4, Air Force Systems Command organized the National Range Division as the central command for all Department of Defense range facilities, with headquarters at Andrews AFB (Maryland). Headquarters of Air Force Missile Test Center (AFMTC) became Headquarters of Air Force Eastern Test Range (AFETR), and Air Force Space Test Center, Provisional, at Vandenberg was redesignated Air Force Western Test Range (AFWTR).[13]

The Eastern and Western Test Ranges were established May 15, 1964, with the understanding that Air Force Western Test Range would gradually assume responsibilities of the Pacific Missile Range for providing range support. Although the transition was scheduled for completion by July 1, 1965, Naval Missile Facility, Point Arguello, became part of Vandenberg July 1, 1964, and by February 1, 1965, the complete transfer was accomplished. PMR continued to operate as a national range under Navy management, but consisted of the Sea Test Range off Point Mugu with stations at San Nicolas and San Clemente Islands, missile impact location stations (MILS) at Wake and Midway Islands, tracking stations at the Barking Sands missile tracking facility on Kauai, Hawaii, and a facility on Johnston Island.[14]

After a White House announcement, NASA Launch Operations Center was renamed John F. Kennedy Space Center (KSC) one week after the assassination of the late President.[15] On October 1, 1965, NASA consolidated under KSC its unmanned launch activities at the Eastern and Western Test Ranges, and both Goddard Space Flight Center's Launch Operations Division and the 22-member Pacific Launch Operations Office were placed under KSC.[16] John F. Kennedy Space Center, NASA, established and maintained a Western Test Range Operations Division at the California launch base.

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[11] DOD Release 1494-63.

[12] AFSC Release 41-5-1.

[13] AFSC Release 45-R-50.

[14] AFSC Release 45-R-61; NASA Announcement 61-161; Zylstra, *Missiles and Rockets* (March 8, 1965), 33-34; Miles, *Los Angeles Times*, July 1, 1964.

[15] Executive Order 11129; NASA Announcement 63-283, Dec. 20, 1963; NASA, *Tenth Semiannual Report* (Washington, D.C.: NASA, 1964), 21; *Marshall Star*, Dec. 11, 1963, 2.

[16] NASA Release 65-313.

Table 6-151. Property: Pacific Launch Operations Office
(as of June 30; money amounts in thousands)

Category[a]	1963	1964	1965
Land in hectares (and acres)			
Owned	0	0	0
Leased	0	0	0
Buildings			
Number owned	11	11	14
Area owned, thousands of sq m	4.5	4.5	6.8
(and sq ft)	(48)	(48)	(73)
Area leased	0	0	0
Value			
Land	0	0	0
Buildings	$ 888	$ 888	$1547
Other structures and facilities	2117	2217	2300
Real property	$3005	$3105	$3847
Capitalized equipment	$ 25	$ 642	$ 246

[a] For definition of terms, see introduction to Chapter Two.

Source: NASA, Office of Facilities.

Table 6-152. Value of Real Property Components as Percentage of Total: Pacific Launch Operations Office
(as of June 30; total real property value in thousands)

Component	1963	1964	1965
Land	0	0	0
Buildings	29.6	28.6	40.2
Other structures and facilities	70.4	71.4	59.8
	100.0	100.0	100.0
Total real property value	$3005	$3105	$3847

Source: Derived from Tables 2-10 through 2-13 in Chapter Two.

Table 6-153. Personnel: Pacific Launch Operations Office

Employee Category[a]	1962	1963		1964		1965
	12/31	6/30	12/31	6/30	12/31	6/30
Requested for FY ending				22		19
Total paid employees	14	17	19	22	21	21
Permanent	12	13	16	17	18	17
Temporary	2	4	3	5	3	4
Code group (permanent only)						
200	0	0	0	0	0	0
700	5	5	5	5	6	6
900	0	0	0	0	0	0
Subtotal	5	5	5	5	6	6
600	3	4	5	4	4	5
500	3	3	4	6	6	4
300	1	1	2	2	2	2
100	0	0	0	0	0	0
Subtotal	7	8	11	12	12	11
Excepted: on duty	0	0	0	0	0	0
Accessions: permanent	3	1	1	2	1	1
Accessions: temporary	2	5	8	8	4	4
Military detailees	0	0	0	0	0	0

[a] For key to Code group numbers and definition of terms, see introduction to Chapter Three.

Source: NASA, Personnel Division.

Table 6-154. Funding by Fiscal Year: Pacific Launch Operations Office
(program plan as of May 31, 1968, in millions)

Appropriation Title	1960	1961	1962	1963	1964	1965	1966	Total
Research and development	–	–	0	$0.20	0	$0.10	0	$0.30
Construction of facilities[a]	$1.11	$0.45	$0.61	0	0	0.28	0	2.45
Administrative operations[b]	–	–	0.12	0.64	0.90	0.85	0.56	3.07
Total	$1.11	$0.45	$0.73	$0.84	$0.90	$1.23	$0.56	$5.82

[a] Does not include facilities planning and design.

[b] Appropriation for FY 1962 was for salaries and expenses; FY 1963 appropriation was for research, development, and operation.

Source: NASA, Office of Programming, Budget Operations Division, *History of Budget Plans, Actual Obligations, and Actual Expenditures for Fiscal Years 1959 Through 1963* (Washington, D.C.: NASA, Feb. 1965); NASA, Budget Operations Division, "Status of Approved Programs," FY 1959–FY 1968, May 1968.

Table 6–155. Actual Obligations for Construction of Facilities by Fiscal Year and Program Year: Pacific Launch Operations Office
(in millions)

Program Year	Program Plan[a]	FY 1960	FY 1961	FY 1962	FY 1963	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	Total
1960	$1.1	$0.8	$0.3	*	-*	0	*	-*	-*	0	$1.1
1961	0.4		0	$0.5	-*	0	0	0	0	0	0.4
1962	0.6			0.3	*	-*	0	0	$0.3	0	0.6
1963	0				0	0	0	0	0	0	0
1964	*					0	*	0	0	0	*
1965	0.4						*	$0.3	*	0	0.3
1966	*							0	*	0	*
1967	0[b]								0.7	-$0.7	1.0[b]
Total	$2.6	$0.8	$0.5	$0.9	-*	-*	*	$0.3	$0.8	$0.7	$2.6

[a] As of June 30, 1968; includes facilities planning and design.

[b] Obligations were made under a previous plan of $1.3 million for launch facilities now reported under Kennedy Space Center.

* = Less than $100 000. Because of rounding, columns and rows may not add to totals.

Source: NASA, Budget Operations Division, "Status of Approved Programs, Construction of Facilities," FY 1959–FY 1968, June 1968; NASA, Financial Management Division, "Summary Financial Status of Programs," June 30, 1968.

WESTERN OPERATIONS OFFICE (WOO)

See Western Support Office (WSO).

WESTERN SUPPORT OFFICE (WSO)

Location: Santa Monica, Los Angeles County, California.

Director: Robert W. Kamm (Sept. 1, 1959-March 1, 1968).
Edwin P. Hartman (Director, NASA Western Coordination Office (WCO), Oct. 1, 1958-Sept. 1, 1959; Director, NACA WCO, 1939-Oct. 1, 1958).

Deputy Director:
E. M. James, Jr. (April 9, 1967-March 1, 1968).
D. R. Mulholland (June 24, 1969-Sept. 1, 1966).

History

In 1939 the NACA established a Western Coordination Office (WCO) in Los Angeles to maintain liaison with the aircraft industry concentrated in the area. Up to 1957, the office had only two employees, and only six in 1959, when a NASA management study recommended a substantial expansion of the installation to meet the increasing workload brought by contracts with the California aerospace industry.[1]

On August 5, 1959, NASA announced that the Office had been reorganized and redesignated Western Operations Office (WOO).[2] In addition to providing liaison with industry, scientific institutions, and universities in the West, the Office was made responsible for administrative and management support of NASA activities west of Denver, Colorado. In its contract administration function, the Western Operations Office dealt with some of NASA's largest contractors, including California Institute of Technology for operation of the Jet Propulsion Laboratory; Rocketdyne Division of North American Aviation, Inc., for the F-1, J-2, and H-1 engines; North American Inc., for the Saturn V second stage and the Apollo spacecraft, and Douglas Aircraft Co. for the Saturn V third stage. The Western Operations Office also participated in development of Delta, Centaur, Atlas-Agena, and Thor-Agena launch vehicles, while furnishing legal and patent counsel, security checks, audits, accounting, disbursement, budgeting, and public information services for NASA field activities in the West.[3]

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[1] Rosholt, *Administrative History of NASA*, 95. The *Data Book* section on history of the Western Support Office was prepared from information provided by Stanley A. Miller, NASA Pasadena Office.

[2] NASA Release 59-206.

Following the 1961 decision to attempt a lunar landing in the 1960s, the growing NASA program, as implemented through large contracts with the West Coast aerospace industry, was reflected in the expansion of the Western Operations Office; it grew more than 350 percent between the beginning of 1962 and mid-1963.[4] On May 11, 1962, NASA announced establishment of the NASA Office-Downey (NASA-O-Downey) as a new element of the Western Operations Office to expedite effective direction of the major development contracts at North American Aviation, Inc., Space and Information Systems Division plant at Downey, California.[5]

On June 15, 1966, as major development projects neared completion and flight tests began, the Western Operations Office was disestablished as a NASA field installation. Its functions were realigned in two component field activities reporting to the NASA Headquarters Office of Industry Affairs—the NASA Office-Downey and the Western Support Office (WSO), established by the June 15 directive.

The Western Support Office was required to provide intermittent technical and safety engineering support to NASA project and program managers, furnish administrative support to NASA-O-Downey, as well as to NASA Resident Office-JPL (redesignated NASA Pasadena Office August 17, 1966), Western Test Range Operations Division of Kennedy Space Center, and Space Nuclear Propulsion Office-Nevada. The Western Support Office also provided legal and security services, handled certain disbursements, and supported the NASA technology utilization and public information programs.[6]

NASA announced November 28, 1967, that, because of FY 1968 budget reductions, the Western Support Office would close.[7] The decision was effective as of March 31, 1968.[8]

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[3] NASA, *Third Semiannual Report* (Washington, D.C.: GPO, 1960), 124; MSC, *Space News Roundup*, Feb. 6, 1963, 5.

[4] Rosholt, *Administrative History of NASA*, 243.

[5] NASA Release 62-115.

[6] NASA Hq. *Weekly Bulletin*, No. 29, July 19, 1966; NASA Management Manual Instruction 1136.27.

[7] NASA Release 67-292.

[8] Phone conversation with J. W. Hughes, Manpower Analysis and Plans Branch, NASA Headquarters, June 16, 1970.

Table 6–156. Industrial Real Property: Western Support Office
(as of June 30; money amounts in thousands)[a]

Category	North American Rockwell Corp.[b] (Contract NAS 7-90 F) NASA Industrial Plant–Downey, Calif.	TRW–Redondo Beach[c] (Contract NAS 7-223 F) Redondo Beach, Calif.	New Mexico State Univ.[c] (Contract NAS 7-424 F) White Sands Missile Range, N. Mex.	Total
	1967	1967	1967	
Land in hectares (and acres)	67.2 (165.9)	0	1128.7 (2789)	1195.9 (2954.9)
Buildings				
Number	82	3	0	85
Area, square meters (and square feet)	161 230.4 (1 735 470)	218.5 (2352)	0	161 448.9 (1 737 822)
Value				
Land	$ 3 617	0	0[d]	$ 3 617
Buildings	23 681	$88	0	23 769
Other structures and facilities	4 981	0	$45	5 026
Total industrial real property	$32 279	$88	$45	$32 412

[a] WSO property was placed under other Centers after March 1, 1968. These 1967 figures are included in Table 6-157; data for earlier years are not available.

[b] Reported by Manned Spacecraft Center in FY 1968.

[c] Reported by Goddard Space Flight Center in FY 1968.

[d] Public Land Order 3685 withdrew this land from the public domain for NASA use. However, its value is not carried on NASA books.

Source: NASA, Office of Facilities.

Table 6–157. Property: Western Support Office
(as of June 30; money amounts in thousands)[a]

Category	1963[b]	1964	1965	1966	1967
Land in hectares (and acres)					
Owned	NA	NA	67.1 (165.9)	1195.9 (2954.9)[c]	1195.9 (2954.9)
Leased	NA	611.5 (1511)	657.6 (1625)	659.3 (1629)	0
Buildings					
Number owned	NA	NA	280	83	85
Area owned, thousands of sq m (and sq ft)	NA	NA	165.7 (1784)	162.2 (1746)	161.5 (1738)
Area leased, thousands of sq m (and sq ft)	3.2 (34)	3.1 (33)	4.4 (47)	4.2 (45)	3.4 (37)
Value					
Land	NA	NA	$ 5 158	$ 3 540	$ 3 617
Buildings	NA	NA	26 077	25 845	23 769
Other structures and facilities	NA	NA	5 055	5 006	5 026
Real property	NA	NA	$36 290	$34 391	$32 412
Captialized equipment	$194	$155	$ 201	$22 465	$22 943

[a] Western Coordination Office was redesignated Western Operations Office, Aug. 5, 1959. Western Operations Office was disestablished June 15, 1966, and its functions realigned in Western Support Office and NASA Office–Downey. Western Support Office was disestablished effective March 1, 1968. For definition of terms, see introduction to Chapter Two.

[b] Data for earlier years are not available.

[c] Part of antenna test range at White Sands operated by New Mexico State University. Reported by Goddard Space Flight Center in FY 1968.

NA = Data not available.

Source: NASA, Office of Facilities.

Table 6-158. Value of Real Property Components as Percentage of Total: Western Support Office
(as of June 30; real property amount in thousands)

Component	1965[a]	1966	1967
Land	14.2	10.2	11.2
Buildings	71.9	75.2	73.3
Other structures and facilities	13.9	14.6	15.5
	100.0	100.0	100.0
Total WSO real property value	$36 290	$34 391	$32 412

[a] Data for earlier years are not available.

Source: Derived from Tables 2-10 through 2-13 in Chapter Two.

Table 6-159. Personnel: Western Support Office[a]

Employee Category	1960		1961		1962		1963	
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31
Requested for FY ending	8		46		85		125	
Total, paid employees	37	50	60	84	136	247	308	318
Permanent	36	49	57	80	130	241	301	310
Temporary	1	1	3	4	6	6	7	8
Code group (permanent only)								
200[b]	1	1	1	2	2	2	2	2
700[c]	10	12	14	17	27	30	35	38
900	0	0	0	0	0	0	0	0
Subtotal	11	13	15	19	29	32	37	40
600[d]	0	17	20	27	41	66	85	89
500	25	19	22	33	55	92	103	104
300	0	0	0	1	5	51	76	77
100	0	0	0	0	0	0	0	0
Subtotal	25	36	42	61	101	209	264	270
Excepted: on duty	1	1	1	1	3	3	3	3
Accessions: permanent	12	16	13	26	61	120	77	21
Accessions: temporary	1	0	4	1	3	4	7	11
Military detailees	0	0	0	0	0	0	0	0

Table 6-159. Personnel: Western Support Office[a] (Continued)

Employee Category	1964 6/30	1964 12/31	1965 6/30	1965 12/31	1966 6/30	1966 12/31	1967 6/30	1967 12/31
Requested for FY ending	500		385		401		381	
Total, paid employees	376	370	377	343	294	105	119	103
Permanent	369	355	352	339	268	97	97	95
Temporary	7	15	25	4	26	8	20	8
Code group (permanent only)								
200[b]	3	3	3	3	0	0	1	1
700[c]	50	51	50	49	45	17	14	14
900	0	0	0	0	0	0	0	0
Subtotal	53	54	53	52	45	17	15	15
600[d]	100	94	95	90	55	24	25	27
500	128	119	117	113	86	55	56	51
300	88	88	87	84	81	0	0	1
100	0	0	0	0	1	1	1	1
Subtotal	316	301	299	287	223	80	82	80
Excepted: on duty	3	3	4	4	3	1	1	1
Accessions: permanent	69	21	10	13	34	6	6	NA
Accessions: temporary	9	17	17	13	26	5	18	NA
Military detailees	0	0	0	0	0	0	0	0

[a] NASA Western Coordination Office was redesignated Western Operations Office Aug. 5, 1959. Personnel figures for 1958-1959 were included in Flight Research Center reports. Western Operations Office was disestablished June 15, 1966, and its functions were realigned in the NASA Office-Downey and the Western Support Office (WSO) established effective June 15, 1966. WSO was disestablished effective March 1, 1968.

[b] Beginning June 30, 1961, the data reflect conversion of some professionals from the 200 Code group (engineers) to the 700 Code group (aerospace technologists). For key to Code group numbers and definition of terms, see Chapter Three.

[c] Data before June 30, 1961, are for "aeronautical research scientists." Beginning June 30, 1961, the data reflect conversion of these personnel members to the 700 Code group (aerospace technologists).

[d] Before Dec. 31, 1960, the data reflect inclusion of Code group 600 personnel in the 500 Code group.

NA = Data not available.

Source: NASA, Personnel Division. Data through Dec. 31, 1966, from NASA Quarterly Personnel Statistical Report; data after Dec. 31, 1966, from Personnel Management Information System and the NASA Supplement to SF 113-A, "Monthly Report of Federal Civilian Employment Short Form."

Table 6-160. Distribution of Permanent Personnel Positions by Fiscal Year and Budget Activity: Western Support Office[a]

Program	1960[b]	1961	1962	1963	1964	1965[e]
Manned space flight		14	23	129	151	173
(% of total)	(16.0)	(23.4)	(16.9)	(42.5)	(40.3)	(44.8)
Space applications		2	8	3	19	7
(% of total)	(3.1)	(3.3)	(5.9)	(1.0)	(5.1)	(1.8)
Unmanned investigations in space		20	82	19	15	35
(% of total)	(6.9)	(33.3)	(60.3)	(6.3)	(4.0)	(9.1)
Space research and technology		16	6	22	35	32
(% of total)	(23.9)	(26.7)	(4.4)	(7.3)	(9.3)	(8.3)
Aircraft technology[c]		6	0	0	0	0
(% of total)	(46.1)	(10.0)	(0.0)	(0.0)	(0.0)	(0.0)
Supporting activities[d]		2	17	130	155	139
(% of total)	(4.0)	(3.3)	(12.5)	(42.9)	(41.3)	(36.0)
Total WSO		60	136	303	375	386

[a] Based on number of actual positions reported in annual NASA Budget Estimates. FY 1961 actual figure was reported in NASA, *Budget Estimates, FY 1963;* FY 1962 actual figure was reported in NASA, *Budget Estimates, FY 1964,* etc.

[b] Actual positions data are not available for FY 1960. Percentages in this column are based on distribution used by NASA Office of Programming, Budget Operations Division, in preparing *History of Budget Plans, Actual Obligations, and Actual Expenditures for Fiscal Years 1959 Through 1963* (Washington, D.C.: NASA, 1965), Sect. 8.

[c] FY 1961 figure represents "aircraft and missile technology."

[d] FY 1963 and later figures include tracking and data acquisition, technology utilization, and general-support positions. Until FY 1963 general-support positions were reported with the five other budget activities. FY 1961 and FY 1962 figures represent only tracking and data acquisition.

[e] Data for later years are not available.

Source: NASA, *Budget Estimates,* FY 1963-FY 1969.

Table 6-161. Funding By Fiscal Year: Western Support Office
(program plan as of May 31, 1968, in millions)

Appropriation Title	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total
Research and development[a]	$0.40	$72.70	$149.30	$216.40	$46.40	$15.70	$18.20	$13.00	$2.20	$534.30
Administrative operations[b]	0.47	5.72	1.38	3.45	4.40	5.04	4.90	3.17	1.25	29.78
Total	$0.87	$78.42	$150.68	$219.85	$50.80	$20.74	$23.10	$16.17	$3.45	$564.08

[a] FY 1961-1963 includes contract with Jet Propulsion Laboratory.

[b] FY 1960-1962 appropriations were for salaries and expenses; FY 1963 appropriation was for research, development, and operation.

Source: NASA, Office of Programming, Budget Operations Division, *History of Budget Plans, Actual Obligations, and Actual Expenditures for Fiscal Years 1959 Through 1963* (Washington, D.C.: NASA, February 1965); NASA, Budget Operations Division, "Status of Approved Programs," FY 1959-FY 1968, May 1968.

Table 6-162. Total Procurement Activity by Fiscal Year: Western Support Office[a]
(money amounts in millions)

	1960	1961	1962	1963	1964	1965	Total
Net value of contract awards	-$.9[b]	$130.6	$266.7	$412.3	$329.1	$346.5	$1484.3
Percentage of NASA total		17%	17%	13%	7%	7%	9.5%

[a] Figures include Jet Propulsion Laboratory.

[b] Includes 109 debit items totaling $6.9 million and 1 credit item (JPL contract) totaling $7.8 million.

Source: NASA, Procurement and Supply Division, *NASA Procurement: October 1, 1958 to June 30, 1960* (Washington, D.C.: NASA, September 1960); NASA, *Annual Procurement Report*, Fiscal Years 1961-1968 (Washington, D.C.: NASA, 1962-1968).

JET PROPULSION LABORATORY

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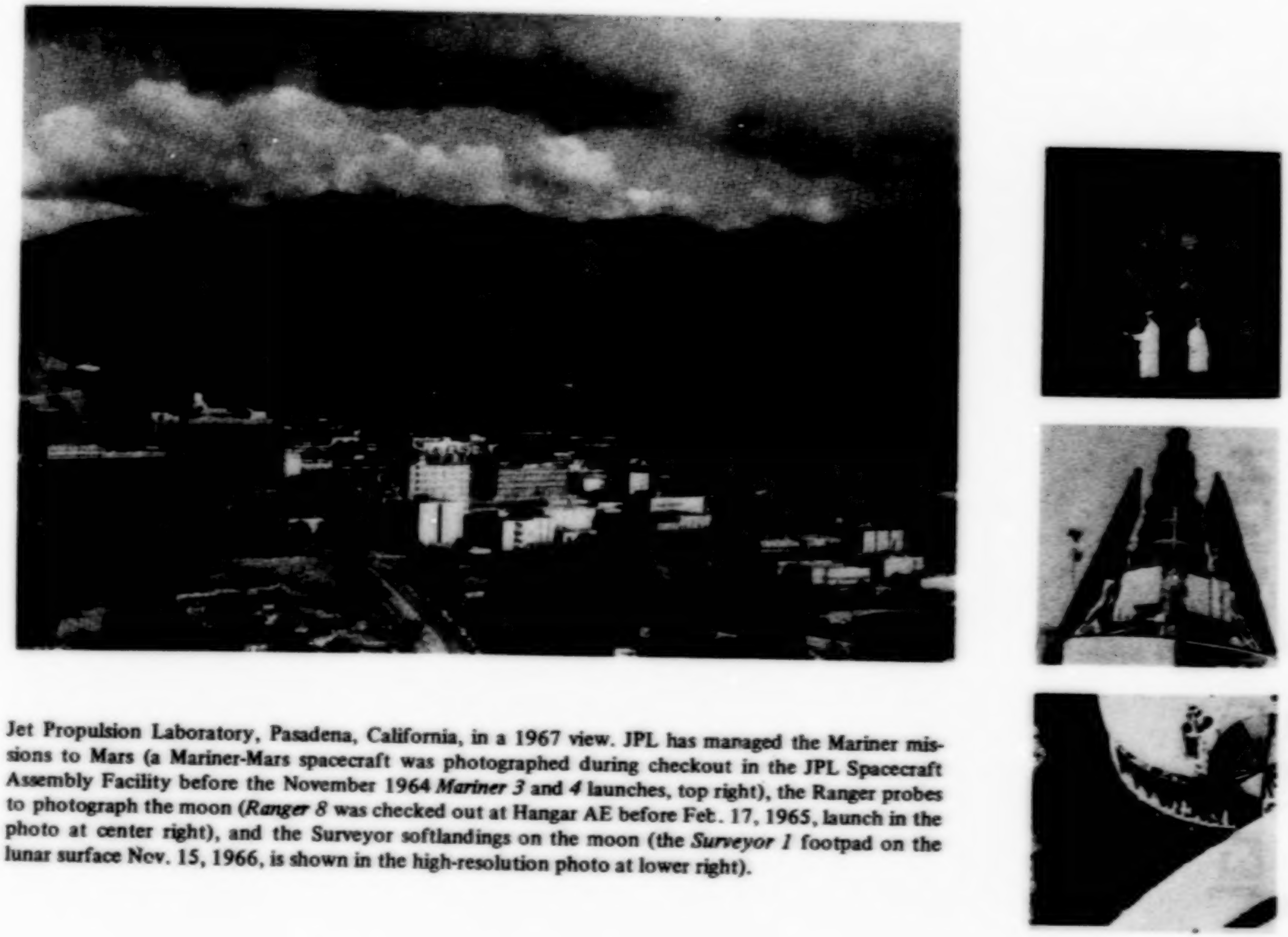

Jet Propulsion Laboratory, Pasadena, California, in a 1967 view. JPL has managed the Mariner missions to Mars (a Mariner-Mars spacecraft was photographed during checkout in the JPL Spacecraft Assembly Facility before the November 1964 *Mariner 3* and *4* launches, top right), the Ranger probes to photograph the moon (*Ranger 8* was checked out at Hangar AE before Feb. 17, 1965, launch in the photo at center right), and the Surveyor softlandings on the moon (the *Surveyor 1* footpad on the lunar surface Nov. 15, 1966, is shown in the high-resolution photo at lower right).

JET PROPULSION LABORATORY (JPL)

(Not a NASA installation; operated by California Institute of Technology under contract to NASA.)

Location: Pasadena, Los Angeles County, California.

Land: 71.3 total hectares (176 acres) as of June 30, 1968:
- 59.1 hectares (145.9 acres) NASA-owned.
- 12.2 hectares (30.1 acres) leases and easements.

Director:
W. H. Pickering (November 1954-).
L. G. Dunn (1947-1954).
F. J. Malina (1944-1946).

Deputy Director:
Rear Adm. John E. Clark (USN, Ret.) (Feb. 19, 1968-).
A. R. Luedecke (August 1964-August 1967).
B. O. Sparks (February 1960-July 1964).

History

Astronomy was a leading discipline at the California Institute of Technology since the institute's origin as the Throop Polytechnic Institute, with astronomer George Ellery Hale (1868-1938) on the Board of Trustees from 1907 until his death. In June 1918 Hale, as Director of Mount Wilson Observatory, offered laboratory space to Robert H. Goddard for rocket experiments. Goddard tested a small solid-fuel rocket for the Signal Corps in August 1918 in a canyon near the present site of the Jet Propulsion Laboratory.[1]

After its founding in 1926, the Guggenheim Aeronautical Laboratory, California Institute of Technology (GALCIT), rapidly developed into one of the Nation's leading schools of aeronautics under the guidance of Dr. Theodore von Kármán. Beginning in 1936, theoretical and empirical experiments on the performance of various jet propulsion engines were conducted by several of von Kármán's graduate students who hoped eventually to construct a high-altitude sounding rocket; formal Government support of this research followed in 1939-1940.[2]

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[1] Helen Wright, *Explorer of the Universe: A Biography of George Ellery Hale* (New York: Dutton, 1966), 299. The *Data Book* section on history of JPL was prepared by R. Cargill Hall, Jet Propulsion Laboratory.

On June 25, 1940, the Army Air Corps awarded Caltech a contract to continue design and development of solid- and liquid-propellant rocket motors for application to "super-performance" of aircraft.[3] Construction of facilities at what is now the site of the Jet Propulsion Laboratory began shortly thereafter, in August 1940. During World War II the GALCIT Rocket Research Project developed the first restricted-burning, "castable," solid-propellant rocket motors and hypergolic red-fuming nitric-acid-aniline liquid-propellant rocket motors, which were employed for jet-assisted takeoff (JATO) of aircraft. Production of these rocket units for the armed services was undertaken by the Aerojet-Engineering Corporation (now Aerojet-General Corporation), formed in 1942.[4]

News of the imminent appearance of the German V-2 rocket in the European theater of operations caused the GALCIT Rocket Research Project to examine the military potential of long-range missiles, and, after analysis, development of long-range missiles was recommended to the U.S. military services.[5] Army Ordnance awarded Caltech a contract June 22, 1944, to design and develop long-range missiles and suitable launching equipment; a few months later–on November 1, 1944–the GALCIT Rocket Research Project was reorganized and renamed the Jet Propulsion Laboratory (JPL), GALCIT. At that time the word "rocket" was still in such bad repute, even in academic circles, that Caltech decided against employing that term: "It is for this reason that the Laboratory at Caltech is called the Jet Propulsion Laboratory rather than the Rocket Propulsion Laboratory."[6]

Under the new mandate JPL designed and developed the liquid-propellant WAC Corporal sounding rocket,[7] the Corporal tactical missile (first U.S. large liquid-fuel rocket), and the solid-propellant Loki antiaircraft rocket and Sergeant missile system during the late 1940s and 1950s. The Laboratory also pioneered in the development of FM-FM radio telemetry and various radio and inertial guidance systems for Army Ordnance which were used in the Corporal and Sergeant missiles and refined for use in the Jupiter IRBM.

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[2] "The Daniel Guggenheim Graduate School of Aeronautics of the California Institute of Technology: A History of the First Ten Years," *Bulletin of the California Institute of Technology*, XLIX, No. 2 (May 1940), 3-5; Frank J. Malina, "Origins and First Decade of the Jet Propulsion Laboratory," in Emme, ed., *History of Rocket Technology*, 52 ff.

[3] Theodore von Kármán, review of "Assisted Take-Off of Aircraft," James Jackson Cabot Fund lecture by Rear Adm. Calvin M. Bolster, Norwich Univ., Northfield, Vt., Publication No. 9, 1950, in *ARS Journal*, No. 85 (June, 1951), 92-93.

[4] Malina, "Origins," 58-59.

[5] Theodore von Kármán, *Memorandum on the Possibility of Long-Range Rocket Projectile*, and H. S. Tsien and F. J. Malina, *A Review and Preliminary Analysis of Long-Range Rocket Projectiles*, Memo JPL-1 (Nov. 20, 1943).

[6] F. J. Malina, *The Jet Propulsion Laboratory, GALCIT*, Memo JPL-3, June 25, 1945, 10; F. L. Wattendorf and F. J. Malina, "Theodore von Kármán, 1881-1963," *Astronautica Acta*, X (1964), 85.

[7] A WAC Corporal mounted on a V-2 first stage (Bumper-WAC) was launched to a record 392.7-km (244-mi) altitude from White Sands, N. Mex., Feb. 24, 1949.

In 1954-55 JPL collaborated with the Army Ballistic Missile Agency in a proposal to construct and launch an artificial earth satellite. The satellite proposal was submitted to the Department of Defense in 1955 and, when the Army was authorized in November 1957 to launch this vehicle, JPL provided the solid-propellant upper stages and the satellite instrumentation. This first American satellite, *Explorer 1*, was successfully launched January 31, 1958.[8] Several months later—December 3, 1958—all contract functions and the Government-owned facilities of JPL were transferred from the Army to the newly created National Aeronautics and Space Administration for the support of NASA's space mission.[9] For the second time California Institute of Technology-Jet Propulsion Laboratory redirected its research and development efforts, this time from missile systems to lunar and planetary exploration. The first joint NASA, JPL, and Army Ordnance Missile Command lunar probes, *Pioneer 3* and *4* were launched in December 1958 and March 1959.

Under contract with NASA in the 1960s California Institute of Technology-Jet Propulsion Laboratory was assigned responsibility for planning, developing, and managing the Ranger (lunar impact), Surveyor (lunar softlander), and Mariner and Voyager (planetary probe) projects for the NASA Office of Space Science and Applications. In addition, under the NASA Office of Tracking and Data Acquisition, JPL developed and operated the NASA Deep Space Network (DSN), a worldwide system of facilities which track, command, control, and receive data from lunar and planetary spacecraft. JPL continued to pursue basic and applied research in support of these space programs.[10]

Mission

Jet Propulsion Laboratory, a nonprofit research and development facility operated under provisions of Contract NAS 7-100 (previously NASw-6) between California Institute of Technology and NASA, was assigned responsibility for conducting lunar, planetary, and deep-space unmanned scientific missions.[11] In carrying out the three basic objectives in this task (space flight projects, Deep Space Network, and research and advanced development in support of current and proposed space missions), the Laboratory maintained a balance in which approximately one half the staff was concerned with flight projects and one quarter with each of the remaining two objectives.[12] Other major support functions included:

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[8] R. Cargill Hall, "Origins and Development of the Vanguard and Explorer Satellite Programs," *The Airpower Historian*, XI, No. 4 (October 1964), 101-112.

[9] Executive Order 10793, 23 F.R. 9405, cited in Rosholt, *Administrative History of NASA*, 47.

[10] U.S. Congress, House, Committee on Science and Astronautics, Subcommittee on Manned Space Flight, *1967 NASA Authorization, Hearings*, Pt. 2, 89th Cong., 2d sess., Feb. 18, 24, March 1-31, 1966 (Washington, D.C.: GPO, 1966), 719.

[11] U.S. Congress, House, Committee on Appropriations, *Independent Offices Appropriations for 1966, Hearings*, Pt. 2, 89th Cong., 2d sess., Feb. 1-April 20, 1966 (Washington, D.C.: GPO, 1965), 1235.

(1) Tracking, data acquisition, data reduction and analysis for lunar and deep space flights.

(2) Space science: analysis of information obtained from ground-based and space flight observations.[13]

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[12] JPL Interoffice Memorandum 42-67, W. H. Pickering to Distribution, Subject: "Review of Aims and Objectives," Aug. 23, 1967.

[13] U.S. Congress, House, Committee on Science and Astronautics, Subcommittee on NASA Oversight, *Project Ranger*, House Rpt. 1487, 88th Cong., 2d sess., June 16, 1964 (Washington, D.C.: GPO, 1964), 10.

GOLDSTONE SPACE COMMUNICATIONS STATION

Location: Mohave Desert, about 72 kilometers (45 miles) north of Barstow, San Bernardino County, California.

Land: About 16 370 hectares (40 450 acres) belonging to Fort Irwin military reservation, leased by NASA from the U.S. Army

History

Goldstone, first deep space facility constructed after the establishment of NASA, became the primary station in the worldwide Deep Space Network (DSN),[1] and in 1968 consisted of four tracking and command sites. Construction of the first facility began in June 1958, when Jet Propulsion Laboratory was still under contract to the Army Ordnance Missile Command, and the Pioneer station and its steerable, paraboloidal reflector antenna with 25.9-meter (85-foot) diameter was completed in time to track the third U.S.-IGY space probe, *Pioneer 3*, launched December 6, 1958–three days after JPL functions and facilities were transferred to NASA jurisdiction. Construction of a second facility, the Goldstone Echo station, also equipped with a 25.9-meter (85-foot) antenna, began July 1959. The Echo station reached operational status in April 1960, in time for the attempted launch of the passive communications satellite Echo A-10.[2] The 25.9-meter antenna at the Echo station was moved to a new site, called the Venus site, in April-May 1962 to create the third Goldstone facility. A new polar-mount, 25.9 meter replacement antenna was completed at the Echo site in June 1962.[3] The Venus station was first used in a radar experiment with the planet Venus in October 1962.

Feasibility studies for a very large advanced antenna system (AAS) began at JPL in December 1960[4] and, following establishment of feasibility, design, and selection of a contractor, excavation of the Mars site–the fourth Goldstone facility–began in October 1963. All structural components for an antenna dish with 64-meter (210-foot) diameter were installed by August 1965 and on April 29, 1966, the largest fully steerable antenna in the United States was officially dedicated.[5] With the new dish, telemetry data reception resumed from the *Mariner 4* spacecraft, which had been launched on a Mars flyby trajectory November 28, 1964.[4]

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[1] NASA Release 66-88. Other stations in the Deep Space Network were at Woomera and Tidbinbilla, Australia (operational November 1960 and March 1965); Johannesburg, South Africa (July 1961); and two sites near Madrid, Spain (Robledo and Cebreros, July 1965 and January 1967). Control center for the network, the Space Flight Operations Facility (SFOF), was at JPL, Pasadena.

The section on history of Goldstone was prepared for the *Data Book* by R. Cargill Hall, Jet Propulsion Laboratory.

[2] NASA Release 66-88. See also JPL, *Ranger 1964-65* (Pasadena: JPL, July 1964), 23.

[3] JPL, *Space Programs Summary No. 37-16*, III, *DSIF* (Pasadena: JPL, July 31, 1962), 10.

[4] JPL Release, Dec. 26, 1960.

[5] JPL *Lab-Oratory* (November 1965), 8-9; NASA Release 66-88.

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[4] U.S. Congress, House, Committee on Science and Astronautics, Subcommittee on Space Science and Applications, *1968 NASA Authorization, Hearings*, Pt. 3, 90th Cong., 1st sess., March 3-22, April 4-19, 1967 (Washington, D.C.: GPO, 1967), 414.

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The 64-meter (210-foot) tracking and communications antenna of the Deep Space Network–directed by JPL for NASA–was photographed in the high desert near Goldstone, California, in 1967. The big dish was officially dedicated April 29, 1966, as the largest fully steerable antenna in the United States.

EDWARDS TEST STATION

Location: Edwards Air Force Base (Mohave Desert), Edwards, Kern County, California.

Land: 230.7 hectares (570 acres) under letter use permit from the USAF.

History

Edwards Test Station was originally known as the ORDCIT Test Station at Muroc, California. Jet Propulsion Laboratory occupied the leased site and several newly constructed buildings at the edge of Muroc Dry Lake April 2, 1945, and began installation of rocket motor testing equipment. A WAC Corporal prototype liquid-propellant motor was first fired September 19, 1945, followed by the first Corporal scale-motor run December 10, 1945.[1]

In the years following 1945 the Muroc Test Center became Edwards Air Force Base and Muroc Dry Lake became known as Rogers Dry Lake. ORDCIT Test Station was rechristened Edwards Test Station in 1954, and the Station came into use as a test facility for chemical propulsion supporting research and advanced development (for example, long-term storage of propellants at a controlled temperature) and for flight-project propulsion tests too hazardous or area-consuming to be conducted at JPL-Pasadena. After 1963, hazardous environmental tests of fueled spacecraft were also made at the Station. Facilities at Edwards consisted of seven rocket stands, magazines and propellant-storage facilities, a test-monitoring-and-recording control center, a spacecraft vibration test building, offices, supporting shops, a photolab, and storage buildings.[2]

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[1] JPL, "Edwards Test Station Marks 10th Birthday," *Lab-Oratory*, IV (April 1955), 3. The *Data Book* section on history of Edwards was prepared by R. Cargill Hall, Jet Propulsion Laboratory.

[2] "Welcome to Edwards Test Station," Visitor's Guide, 1967.

TABLE MOUNTAIN OBSERVATORY

Location: Table Mountain, Near Wrightwood, California.

Land: 4.3 hectares (10.5 acres) under letter use permit from the U.S. Department of Agriculture, Forestry Division.

History

The Table Mountain site was operated by the Smithsonian Astrophysical Observatory from its construction in 1920 until 1962, when Jet Propulsion Laboratory purchased existing structures and began a construction and rebuilding program.[1] Existing structures were two concrete bunkers, used for taking spectrograms of the sun and the earth's atmosphere, and several wood-frame buildings.

Construction of an observatory–for a 40-centimeter (16-inch) reflecting telescope–and a darkroom began in May 1962; work was completed and the observatory began operations in October of that year. In the following year, 1963, work began on a high-precision radioastronomy antenna with 5.5-meter (18-foot) diameter, for very short wavelengths. This construction was completed and the antenna placed in operation in 1964.

A second, larger observatory and requisite darkrooms were built in two sections during 1965-1966. Work on the first section–to accommodate a 61-centimeter (24-inch) reflecting telescope–began in October 1965 and was completed in February 1966. Construction of the addition to the observatory was completed in December 1966; it housed a spectrometer for studying planetary atmospheres. The spectrometer used the 61-centimeter telescope as its source of light. An additional large spectrograph was under construction in 1968.[2]

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[1] NASA, *Technical Facilities Catalog* (March 1967 ed.), I, 8-114. The *Data Book* section on history of Table Mountain Observatory was prepared by R. Cargill Hall, Jet Propulsion Laboratory.

[2] Interview with Ray Newburn, JPL Technical Manager of Table Mountain Observatory 1962-1967, Jan. 11, 1968.

Table 6-163. Technical Facilities: Wind Tunnels
(with costs in thousands)

Facility Name	Year	Test Section Size	Mach No. Range	Reynolds No. Range	Init. Cost	Accum. Cost	Research Supported
20-inch supersonic wind tunnel	1950	NA	1.3 to 5.6	Varies with mach. no.	$2800	$3800	Force, pressure, heat-transfer, static and dynamic stability measurements
21-inch hypersonic wind tunnel	1959	NA	4 to 11	Varies with mach. no.	6500	9500	Force, pressure, heat-transfer, static and dynamic stability measurements
Low-density gas-dynamics facility (LDGDF)	1959	NA	NA	NA	50	150	Fluid physics
Liquid sodium tunnel	1961-1962	50-mm dia (2-in dia)	0.9 to 12.2 m per sec (3 to 40 fps)	NA	100	150	Magneto-fluid dynamics
6-inch arc-heated shock tube	1962	NA	10 058 m per sec (33 000 fps)	NA	75	240	Aerothermodynamics studies for support of planetary missions; radiative and convective heat transfer
12-inch free-piston shock tube	1963	NA	30	NA	75	225	Aerothermodynamics studies for support of planetary missions; radiative and convective heat transfer
43-inch shock tunnel	1964	NA	12	NA	50	100	Pressure distribution, distributed heat-transfer measurements, flow studies
Low-turbulence wind tunnel	1966	0.6 x 0.6 x 2.7 m L (2 x 2 x 9 ft L)	0 to 24.4 m per sec (8 to 80 fps)	NA	12	12	Fluid mechanics, turbulence, viscous flow

NA = Data not available.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), I, Sect. 8; Append. B.

Table 6-164. Technical Facilities: Environmental Test Chambers
(with costs in thousands)

Functional Name	Facility Name	Year Built	Dimensions Meters (feet)	Pressure	Temperature	Init. Cost	Accum. Cost	Research Supported
Climatic environments test laboratory	Environmental and Dynamic Testing Laboratory, Natural Environments	1961	0.3 x 0.3 x 0.3 (1 x 1 x 1)	–	200 to 589 K (-100° to +600°F)	$ 70	$ 147	Component and spacecraft subassembly temperature and humidity testing
			0.6 x 0.3 x 0.3 (2 x 1 x 1)	–	200 to 589 K (-100° to +600°F)			
			0.9 x 0.9 x 0.9 (3 x 3 x 3)	–	200 to 450 K (-100° to +350°F)			
			0.9 x 0.9 x 0.9 (3 x 3 x 3)	–	200 to 394 K (-100° to +250°F)			
			0.9 x 0.9 x 0.9 (3 x 3 x 3)	–	200 to 422 K (-100° to +300°F)			
			0.9 x 0.9 x 0.9 (3 x 3 x 3)	–	89 to 394 K (-300° to +250°F)			
			1.8 x 0.9 x 0.9 (6 x 3 x 3)	–	200 to 422 K (-100° to +300°F)			
Environmental test facility	Environmental and Dynamic Testing Laboratory, Natural Environments	1961	2.1 dia x 4.3 L (7 dia x 14 L)	8×10^{-8} torr	89 to 367 K (-300° to +200°F)	180	260	Testing of spacecraft and spacecraft subsystems
Environmental test facility	Environmental and Dynamic Testing Laboratory, Natural Environments	1961	0.6 dia x 1.0 L (2 dia x 3 L)	2×10^{-7} torr	89 to 408 K (-300° to +275°F)	122	253	Spacecraft subsystems and small components launch and space vacuum simulation
	Environment and Dynamic Testing Laboratory, Natural Environments		0.6 dia x 1.1 L (2.1 dia x 3.3 L)	2×10^{-7} torr	89 to 408 K (-300° to +275°F)			
	Environmental and Dynamic Testing Laboratory Natural Environments		0.8 dia x 1.4 L (2.5 dia x 4.5 L)	2×10^{-7} torr	89 to 408 K (-300° to +275°F)			
Environmental test facility	25-Foot Space Simulator	1962	7.6 dia x 27.4 H (25 dia x 90 H)	5×10^{-6} torr	94 K (-290°F)	4266	6766	Extreme-cold, high-vacuum, and intense-solar-radiation testing of spacecraft
Environmental test facility	10-Foot Space Simulator	1965	3.1 dia x 13.7 H (10 dia x 45 H)	5×10^{-6} torr	94 K (-290°F)	1577	1577	Extreme-cold, high-vacuum, and intense-solar-radiation testing of spacecraft

NA = Data not available

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), I, Sect. 8; Append. A.

Table 6-165. Technical Facilities Other Than Wind Tunnels and Environmental Test Chambers
(with costs in thousands)

Functional Name	Facility	Year Built	Init. Cost	Accum. Cost	Research or Technological Areas Supported
Energy sources facility	Energy Sources Facility	1943	$ 2	$ 7	Liquid metals
Liquid metals laboratory	Energy Sources Facility	1944	19	408	Liquid metals
Materials laboratory	Energy Sources Facility	1944	3	82	Liquid metals
Heat transfer laboratory	Heat Transfer Laboratory	1945	37	85	Subsonic, supersonic, accelerating and and decelerating air flows, and ionized gas flows
Plasma research facility, low pressure	Plasma Flow Research Laboratory	1947	88	636	Interaction of electric and magnetic fields with plasmas
Hydraulic test laboratory	Hydraulic Test Laboratory	1947	85	100	Simulated testing of propulsion components, subsystems, and related R&D
Gas metering laboratory	Gas Metering Laboratory	1951	125	150	Simulated testing of propulsion components, subsystems, and related R&D
Polymer chemistry laboratory	Polymer Chemistry Laboratory	1951	73	122	Polymers; spacecraft materials
Energy sources facility	Energy Sources Facility	1954	22	33	Liquid metals
Propulsion application laboratory, electric	Electric Propulsion Application Laboratory	1955	16	216	Ion thruster systems (R&D)
Power conversion laboratory	Power Conversion Laboratory	1956	63	259	Liquid MHD power conversion

Table 6-165. Technical Facilities Other Than Wind Tunnels and Environmental Test Chambers (Continued)
(with costs in thousands)

Functional Name	Facility	Year Built	Init. Cost	Accum. Cost	Research or Technological Areas Supported
Centrifuge laboratory	Environmental and Dynamic Testing Laboratory, Induced Environments	1960	$ 15	$ 15	Spacecraft components and subassemblies
Vibration test facility	Environmental and Dynamic Testing Laboratory, Induced Environments	1961	362	460	Spacecraft and component vibration-environment simulation
Radiation facility, high-energy ionizing	10 Kilocurie – Co^{60} Source	1961	5	15	Radiation chemistry
Celestarium–sun and star simulator	Celestarium–Sun and Star Simulator	1961	102	116	Spacecraft reflection test and Canopus-sensor stray-light test
Star planet simulator laboratory	Star Planet Simulator Laboratory	1963	50	50	Star and planet tracker development testing
Optical performance testing laboratory	Optical Laboratory Tunnel	1963	500[a]	600	Optical modulation transfer function, resolving power, aberrations, distortion, photometric response, etc., of optical equipment
Accelerator facility, positive ion	Dynamitron	1963	250	310	Electrophysics, nuclear fission, atomic stopping, secondary electron production
Shock test facility	Shock Machine, Environmental and Dynamic Testing Laboratory	1963	35	35	Component and spacecraft subassembly shock testing
Magnetic facility, high field	High Field Magnet Facility	1964	200	245	Low-temperature physics and magnetic resonance

Table 6-165. Technical Facilities Other Than Wind Tunnels and Environmental Test Chambers (Continued)
(with costs in thousands)

Functional Name	Facility	Year Built	Init. Cost	Accum. Cost	Research or Technological Areas Supported
Acoustic environments laboratory	Environmental and Dynamics Testing Laboratory, Induced Environments	1964	$190	$190	Spacecraft and component acoustic-environment simulation; equipment R&D
Control systems simulation laboratory	Control Systems Simulation Laboratory	1964–65	40	40	Simulations and feasibility demonstrations
Sterlization and experimental assembly laboratory	Experimental Assembly and Sterilization Laboratory (EASL)	1965	122	122	Electromechanical assembly under biologically clean conditions
Spectroscopy laboratory, long path absorption	Spectrosopy Laboratory and Absorption Tube	1965	153	800	Atmospheric physics, planetary astronomy
Magnetic field facility	Low Magnetic Field Facility	1965	88	130	Low-field magnetometer evaluation and calibration, assembly magnetic mapping, and superconductivity studies
Inertial sensor laboratory	Inertial Sensor Laboratory	1965	100	103	Determination of operating parameters of gyros and accelerometers for spacecraft systems
Sterilization assembly development laboratory	Sterilization Assembly Development Laboratory (SADL)	1967	999	999	Design requirements of capsule systems and for facilities to satisfy planetary quarantine requirements
Geomagnetic Observatory[b]	Extremely-Low-Frequency Magnetic Field Observatory	1964	30	35	Geomagnetic field monitoring and correlation with magnetic data taken from OGO spacecraft

[a] Equipment, not building.
[b] At Morris Dam, Azusa Canyon, Calif.

NA = Data not available.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), I, Sect. 8.

Table 6-166. Technical Facilities: Edwards Test Station
(with costs in thousands)

Functional Name	Facility	Year Built	Init. Cost	Accum. Cost	Research or Technological Areas Supported
Propellant processing facility	Solid Propellant Processing Area	1962–1965	$583	$651	Solid-propellant motor development, rocket materials and components development, and sterilizable rocket motor development
Propellant casting facility	Casting Building	1963	42	242	Solid-propellant motor development, rocket materials and components development, and sterilizable rocket motor development
Propellant mixing facility	Mixer Building	1963	26	54	Solid-propellant motor development, rocket materials and components development, and sterilizable rocket motor development
Vibration test facility	Environmental and Dynamic Testing Laboratory, Induced Environments	1964	330	500	Hazardous spacecraft and subassembly vibration testing
Propellant compatibility test facility	Propellant Compatibility Test	1966	66	92	Elevated temperature tests
Rocket propulsion test stands:	"A" Stand	1947	75	200	Flow meter calibrations, bladder and diaphragm expulsion pumping tests
	"Baker" Stand	1952	50	200	Combustion; engine and injector development
	"C" Stand	1957	100	400	R&D static firings of cryogenic or earth-storable propellants
	"D" Vertical	1959	276	295	System and component tests, injector and thrust chamber development using earth-storable propellants

Table 6-166. Technical Facilities: Edwards Test Station (Continued)
(with costs in thousands)

Functional Name	Facility	Year Built	Init. Cost	Accum. Cost	Research or Technological Areas Supported
Rocket propulsion test stands (continued):	"D_j"[a]	1960	$ 42	$102	Injector and chamber development tests using earth-storable propellants
	"D_y & D_d" Altitude Test Positions[a]	1960	104	325	Injector and fully expanded chamber development tests using earth-storable propellants; miscellaneous component vacuum tests
	Solid	1962	42	59	Solid-fuel-rocket ballistic investigation, ignition studies, materials and component development
	"F"	1964	100	200	Materials, components, and system evaluation under hazardous conditions

[a] Part of D stand complex.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), I, Sect. 8, 83–110.

Table 6-167. Technical Facilities: Table Mountain Observatory
(with costs in thousands)[a]

Functional Name	Facility	Year Built	Init. Cost	Accum. Cost	Research or Technological Areas Supported
Astronomical observatory, optical and radio[b]	Table Mountain Observatory	1962	-	$600	Studies of bodies in the solar system to furnish possible descriptions of their atmospheres and surfaces
Solar panel test facility	Solar Test Facility	1963	25	47	Photovoltaics
Solar tracker	Solar Tracker	1965-1966	70	70	Thermionic converter and generator development

[a] The Table Mountain site was occupied under a special use permit granted by the U.S. Dept. of Agriculture, Forestry Division. The site was developed by the Smithsonian Institution in the 1920s and used for solar observations until acquisition by JPL in 1962. The $12 000 "initial cost" is the payment for several old wood-frame buildings left by the Smithsonian.

[b] 61-cm (24-in) and 40-cm (16-in) reflecting telescopes and 5.5-m (18-ft) radiotelescope.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), I, Sect. 8, 113-118.

Table 6–168. Property
(as of June 30; money amounts in thousands)[a]

Category	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
Land in hectares (and acres)										
Owned	30.5	30.5	34.7	59.5	59.5	59.1	59.1	59.1	59.1	59.1
	(75.2)	(75.2)	(85.8)	(146.9)	(146.9)	(145.9)	(145.9)	(145.9)	(145.9)	(145.9)
Leased	30.6	32.3	29.3	4.7	4.7	5.8	5.9	5.9	5.8	5.8
	(75.5)	(79.8)	(72.6)	(11.5)	(11.5)	(14.3)	(14.4)	(14.4)	(14.3)	(14.3)
Buildings										
Number owned	102	114	122	142	164	180	187	151	189	343
Area owned, thousands of sq m	40.7	43.9	54.4	62.3	69.3	98.2	116.7	122.3	129.5	159.5
(and sq ft)	(438)	(473)	(586)	(670)	(746)	(1057)	(1256)	(1316)	(1394)	(1717)
Area leased	0	0	0	0	0	0	0	0	0	0
Value										
Land	$ 117	$ 117	$ 267	$ 807	$ 802	$ 802	$ 802	$ 802	$ 799	$ 799
Buildings	6 709	7 239	10 631	14 658	16 736	25 799	31 872	34 695	38 543	50 456
Other structures and facilities[b]	3 693	4 725	5 345	6 457	7 275	6 793	8 473	11 678	9 278	27 516
Real property	$10 519	$12 081	$16 243	$21 922	$24 813	$33 394	$41 147	$47 175	$48 620	$ 78 771
Capitalized equipment	$10 322	$12 335	$18 220	$26 028	$34 300	$46 894	$62 873	$79 252	$92 093	$103 796

[a] All NASA industrial real property under Contract No. NAS 7–270 F between California Institute of Technology and NASA; for 1967 breakdown of JPL facilities, see section on NASA Pasadena Office–JPL in this chapter.

[b] Definition of "other structures and facilities" was refined in 1968 to include electrical, water, sewage, gas, communication system, road, and other improvements to real property.

Source: NASA, Office of Facilities. Supplementary information was provided by P. E. Mayer, Property Administration Section, JPL.

Table 6-169. Value of Real Property Components as Percentage of Total
(as of June 30; total real property value in thousands)

Component	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
Land	1.1	1.0	1.6	3.7	3.3	2.4	1.9	1.7	1.6	1.0
Buildings	63.8	59.9	65.5	66.9	67.4	77.3	77.5	73.5	79.3	64.1
Other structures and facilities	35.1	39.1	32.9	29.4	29.3	20.3	20.6	24.8	19.1	34.9
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total JPL real property value	$10 519	$12 081	$16 243	$21 922	$24 813	$33 394	$41 147	$47 175	$48 620	$78 771

Source: Derived from Tables 2-10 through 2-13 in Chapter Two.

Table 6-170. Personnel: Jet Propulsion Laboratory

Employee Category[a]	1958		1959		1960		1961		1962		1963	
	9/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31
Manpower quota				2609[a]		3010		3495		3878		4188
Permanent employees	2266	2328	2662	2626	2743	2655	2817	3091	3497	3821	4004	4134
Accessions		58		36		88		274		324		130
Military detailees	0	0	0	0	0	9[b]	10	13	17	23	17	17

Table 6-170. Personnel: Jet Propulsion Laboratory (Continued)

Employee Category	1964		1965		1966		1967		1968	
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31
Manpower quota		4275		4150		4400		4650	4150	
Permanent employees	4291	4268	4027	4016	4069	4333	4565	4377	4102	
Accessions		23		11		264		188	194	
Military detailees	17	17	17	16	16	16	19	19	13	

[a] Quotas not assigned until Dec. 31, 1959.
[b] Program began in FY 1961.

Source: JPL, Personnel Office.

Table 6–171. Actual Obligations for Construction of Facilities by Fiscal Year and Program Year
(in millions)

Program Year	Program Plan[a]	FY 1960	FY 1961	FY 1962	FY 1963	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	Total
1960	$7.7	$7.4	*	$0.3	0	0	–*	0	0	0	$ 7.7
1961	8.6		$6.9	1.7	*	0	0	0	*	0	8.6
1962	4.1			4.0	*	0	0	0	–*	–*	4.1
1963	11.6				$10.3	$1.4	0	*	–*	0	11.6
1964	3.2					3.2	*	0	–*	*	3.2
1965	4.0						$3.8	$0.1	*	0	4.0
1966	1.1							1.1	–*	*	1.1
1967	0.8								$0.6	$1.0	0.7
1968	1.9									0.9	0.9
Total	$43.0	$7.4	$6.9	$5.9	$10.3	$4.6	$3.9	$1.2	$0.6	$1.0	$41.9[b]

[a] As of June 30, 1968; includes facilities planning and design.
[b] Includes $1.2 million for tracking and data-acquisition facilities.

* = Less than $100 000. Because of rounding, columns and rows may not add to totals.

Source: NASA, Budget Operations Division, "Status of Approved Programs, Construction of Facilities," FY 1959–FY 1968, June 1968; NASA, Financial Management Division, "Summary Financial Status of Programs," June 30, 1968.

Table 6-172. Awards to Personnel Granted under Section 306 of the Space Act of 1958[a]

Year	Inventor	Contribution	Amount
1963	Conrad Josias	Bipolar logarithmic current-to-voltage transducer	$1000
	James D. Acord Howard C. Vivian	Space vehicle attitude control	1000
	Walter K. Victor Eberhardt Rechtin	Space communication system	5000
1964	William W. Smith Bruce W. Schmitz	Trajectory-correction propulsion system	1000
	John F. Meyer	Low-speed time multiplexing	1300
	Gerald W. Meisenholder James D. Acord Howard C. Vivian Louis F. Schmidt	Sensing devices	1600
1966	Robert K. Yasui	Solar-cell submodule	1000
1967	Richard C. Turner	A thermo couple assembly	1000
	Richard A. McKay	Temperature control system for circulating fluids	1000
1968[b]	David W. Passell	Decorder/actuator device	50
	Charles T. Stelzried Donald L. Mullen	Broadband microwave waveguide window	100
	Robin A. Winkelstein	Noninterruptable digital counting system	700
	Alan R. Johnston	Polarimeter for transient measurement	1400
	Franklin L. Murphy	Bimetallic power-controlled actuator	500
	James M. Kendall, Sr. Joseph A. Plamondon, Jr	Absolute cavity radiometer	1100

[a] For complete listing of awards under this Act, see Appendix A, Sect. I.B.

[b] As of June 30.

Source: NASA, Inventions and Contributions Board.

APPENDIX A

SELECTED AEROSPACE AWARDS

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APPENDIX A

SELECTED AEROSPACE AWARDS

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APPENDIX A

SELECTED AEROSPACE AWARDS

1. National Aeronautics and Space Administration

A. NASA Honor Awards

Certificate of Appreciation

The NASA Certificate of Appreciation is usually granted to an individual upon separation from Headquarters to mark dedicated and significant service, or a substantial contribution, to his organization.

1962 Hiden Cox
Robert S. Boyd
William C. Howe
Eugene W. Lovelace
1963 Don D. Cadle
Robert H. Charles
Abraham Hyatt
Addison M. Rothrock
Carroll A. Towne
1964 James C. Elms
James E. Love
Mervin Kelly
Joseph R. Vensel
Brig. Gen. Thomas J. Hayes III (USA)
George M. Knauf, M.D.
Philip T. Drotning
Edwin P. Hartman
Robert E. Warren
1965 Ricardo Monges Lopez
Ernest L. Struttman
Albert A. Vollmecke
1966 James A. Hootman
1967 Edward Z. Gray
George D. McCauley
David H. Stoddard, M.D.
Herbert L. Brewer
Robert W. Kamm
1968 Max A. Heaslet
Bernhardt L. Dorman

Distinguished Service Medal

The NASA Distinguished Service Medal, NASA's highest award, is given to any person in Federal service, who, "by distinguished service, ability, or courage, has personally made a contribution representing substantial progress to aeronautical or space exploration in the interests of the United States." Recommendations for this award are reviewed by the NASA Incentive Awards Board.

1959 John W. Crowley
1961 Lt. Cdr. Alan B. Shepard, Jr. (USN)
Capt. Virgil I. Grissom (USAF)
1962 Lt. Col. John H. Glenn, Jr. (USMC)
Robert R. Gilruth
Joseph A. Walker

Distinguished Service Medal (Continued)

Lt. Cdr. M. Scott Carpenter (USN)
Walter C. Williams
Cdr. Forrest S. Petersen (USN)
Maj. Robert M. White (USAF)
Lt. Cdr. Walter M. Schirra, Jr. (USN)
1963 Maj. L. Gordon Cooper, Jr. (USAF)
1965 Maj. Virgil I. Grissom (USAF)
William H. Pickering
Capt. Walter M. Schirra, Jr. (USN)
Maj. Donald K. Slayton (USAF, Ret.)
Robert C. Seamans, Jr.
1966 Hugh L. Dryden (posthumously)
T. Keith Glennan
Gen. Bernard A. Schriever (USAF, Ret.)
George E. Mueller
Charles W. Mathews
1967 Walter D. Sohier
Homer E. Newell
Edgar M. Cortright
Floyd L. Thompson
Raymond L. Bisplinghoff
1968 Edmond S. Buckley
Paul G. Dembling
Alexander H. Flax
Abe Silverstein
James E. Webb

Distinguished Public Service Medal

The NASA Distinguished Public Service Medal is granted only to individuals whose meritorious contributions produced results which measurably improved, expedited, or clarified administrative procedures, scientific progress, work methods, manufacturing techniques, personnel practices, public information services, and other efforts related to the accomplishment of the mission of NASA. It is granted to any United States citizen who is not an employee of the Federal Government or was not an employee during the period in which the service was performed.

1966 Lloyd V. Berkner
1967 Charles Stark Draper
1968 No award given

Exceptional Bravery Medal

The NASA Medal for Exceptional Bravery is given for exemplary and courageous handling of an emergency in NASA program activities by an individual who, independent of personal danger, has acted to prevent the loss of human life or Government property. This medal was first awarded in 1963.

1963 Capt. Paul J. Balfe (USAF)
John A. Gordon
A3/c Larry J. Hough (USAF)
Curtis C. Lyon
T/Sgt. Charles L. Manes (USAF)
Capt. Lynn B. Rowe (USAF)
1967 Donald O. Babbitt
Stephen B. Clemmons
James D. Gleaves
Jerry W. Hawkins
L. D. Reece
Henry H. Rogers

Exceptional Scientific Achievement Medal

The NASA Exceptional Scientific Achievement Medal is an award given for unusually significant scientific accomplishments which contribute to the programs of the National Aeronautics and Space Administration, the Department of Defense, and other Government agencies.

1961	William J. O'Sullivan
1962	Robert E. Bourdeau
	John C. Lindsay
1963	Ernst D. Geissler
	Dean R. Chapman
	John C. Houbolt
1964	William R. Lucas
	Frank B. McDonald
	Ernst Stuhlinger
	Daniel G. Mazur
1965	Harris M. Schurmeier
	Jack N. James
	Dan Schneiderman
	Eberhardt Rechtin
	Leslie H. Meredith
	William Nordberg
	H. Julian Allen
1966	Richard F. Arenstorf
	Helmut J. Horn
	Norman F. Ness
	George F. Pezdirtz
	James A. Chamberlin
1967	Richard V. Rhode
	Michel Bader
	Donald E. Gault
	Walter B. Horne
	Samuel S. Manson
	William H. Phillips
	Eugene M. Shoemaker
	Israel Taback
	Maurice D. White
1968	Mervin G. Ault
	Edmond E. Bisson
	John C. Evvard
	Richard M. Goldstein
	Otto A. Hoberg
	Hans H. Hosenthien
	Robert D. Jastrow
	Lewis D. Kaplan
	Mark R. Nichols
	William A. Page
	John A. Parker
	Alan Rembaum
	Conway W. Snyder

Exceptional Service Medal

The NASA Exceptional Service Medal is the second highest award in the NASA Incentive Awards Program. It is granted for significant achievement or service characterized by unusual initiative or creative ability that clearly demonstrates substantial improvement in engineering, administrative, space flight, or space-related endeavors which contribute to NASA programs.

1964	I. Edward Garrick
	Hans F. Greune
	Wesley L. Hjornevik
	Leonard Jaffe
	Oran W. Nicks
1965	Cdr. John W. Young (USN)
	Maj. Virgil I. Grissom (USAF)
	Lt. Col. Edward H. White II (USAF)
	Lt. Col. James A. McDivitt (USAF)
	George L. Simpson, Jr., M.D.
	Gerald D. O'Brien
	Charles A. Berry, M.D.
	Lt. Cdr. Charles Conrad, Jr. (USN)
	Maj. L. Gordon Cooper, Jr. (USAF)

Exceptional Service Medal (Continued)

William F. Lilly
Seymour C. Himmel
John R. Casani
Maj. Gen. O. J. Ritland (USAF)
1965 Capt. Walter M. Schirra, Jr. (USN)
Maj. Thomas P. Stafford (USAF)
Lt. Col. Frank Borman (USAF)
Cdr. James A. Lovell, Jr. (USN)
William C. Schneider
John T. Mengel
1966 Neil A. Armstrong
Lt. Col. David R. Scott (USAF)
Morris Tepper, M.D.
Herbert I. Butler
David S. Johnson
Lt. Cdr. Eugene A. Cernan (USN)
Maj. Thomas P. Stafford (USAF)
Cdr. John W. Young (USN)
Maj. Michael Collins (USAF)
Lt. Cdr. Charles Conrad, Jr. (USN)
M. Helen Davies
Herbert A. Wilson
Lt. Col. Robert A. Rushworth (USAF)
Roll D. Ginter
David S. Gabriel
Edmund R. Jonash
J. Cary Nettles
Wilfred E. Scull
Col. Richard E. Dineen (USAF)
Lt. Cdr. Richard F. Gordon, Jr. (USN)
Harry Press
Leland F. Belew
Lee B. James
Col. William G. Johnson (USMC)
Peter A. Minderman
Capt. James A. Lovell, Jr. (USN)
Lt. Col. Edwin E. Aldrin, Jr. (USAF)
Col. John G. Albert (USAF)
Ozro M. Covington
John D. Hodge
William B. Rieke
1967 Robert F. Garbarini
Albert J. Kelley
Maj. Gen. David M. Jones (USAF)
Lt. Cdr. Roger B. Chaffee (USN) (posthumously)
Donald R. Bellman
William J. Boyer
William Cohen
George C. Deutsch
Robert H. Gray
Howard H. Haglund
Charles F. Hall
Arthur F. Hood
James J. Kramer
Laurence K. Loftin, Jr.
Joseph B. Mahon
Paul G. Marcotte
James S. Martin, Jr.
Benjamin Milwitsky
Clifford H. Nelson
Robert J. Parks
H. Warren Plohr
Robert D. Reed
Lee R. Scherer
William M. Shea
1968 Mac C. Adams
Walter F. Boone
Donald D. Buchanan
Richard L. Callaghan
R. Walter Cunningham
Robert J. Darcey
Philip Donely
Robert C. Duncan
Maj. Donn F. Eisele (USAF)
Fred H. Felberg
Arnold W. Frutkin
Paul F. Fuhrmeister
Harry H. Hamilton
Herman E. Lagow
Alvin R. Luedecke
Glynn S. Lunney
Robert J. McCaffery
Mildred V. Morris
Boyd C. Myers
Rocco A. Petrone
Isom A. Rigell
Arthur L. H. Rudolph
William R. Schindler
Capt. Walter M. Schirra, Jr. (USN)
Albert F. Siepert
Hubert R. Stanley
Michael J. Vaccaro

Group Achievement Award

The NASA Group Achievement Award is presented in recognition of a meritorious achievement which does not fall within the scope of other NASA awards. It is granted to a group for an outstanding contribution or achievement which is sufficiently above normal work standards to warrant special recognition or which has resulted in specifically identifiable or monetary benefits to the Government.

1962	Preflight Operations Division, MSC
	Assistant Directorate for Engineering and Development, MSC
	Mercury Project Office, MSC
	Flight Operations Division, MSC
	Directorate for Tracking and Data Systems, GSFC
	Staff of Wallops Station
1963	Delta Project Group, GSFC
	Tiros Project Group, GSFC
	Recruiting and Examining Branch, Personnel Division–Office of Administration, NASA Hq.
	Department of Defense Recovery Forces
	Air Force Space Systems Division
1964	X-15 Research Airplane Flight Test Organization, FRC
	Automatic Data Processing Branch, Administrative Services Division–Office of Administration, NASA Hq.
	Centaur "E" Stand Project Personnel, LeRC
	Saturn I Launch Team, KSC
	Saturn Booster Team, MSFC
1965	Syncom Group–NASA Hq. and GSFC
	OGO Experiment Qualification Group, GSFC
	Radar Tracking Group, Wallops Station
	Management and Operational Group, Wallops Station
	Meteorological Group, U.S. Weather Bureau Personnel, Wallops Station
	Vehicle Assembly and Launch Crew, Wallops Station
	Flight Services Group, Wallops Station
	Scout Project Office, LaRC
	MSC-Florida Operations Team, KSC
	Launch Support, Equipment Engineering Division, KSC
	Agena Project Group, LeRC
	Launch Operations Team, Gemini VII/VI, MSC
1966	Department of Defense Recovery Forces
	Advanced Antenna Project Team, JPL
	Centaur Project Personnel, LeRC
	Project Fire, LaRC
	Pegasus Program, LaRC, Headquarters, and MSFC
	Space Nuclear Propulsion Office, NASA Hq.
	Gemini Astronaut Team, MSC
	Manned Space Flight Network Team, GSFC
	Gemini Spacecraft Launch Team, KSC
	Gemini Launch Operations and Range Support Team, USAF
	Gemini Program Office, MSC
	Gemini Program Office, NASA Hq.
	Gemini Support Team, MSC
1967	Apollo 204 Review Board, KSC
	Supersonic Transport NASA Evaluation Team
	Lunar Orbiter Spacecraft and Operations Team
	260-inch Solid Motor Project Team
1968	*Apollo 7* Flight Operations Team
	Instrumentation Ships Team
	Mariner Occultation Experiment Team
	OGO Project Team
	Sonic Boom Investigating Team
	Surveyor Team

Outstanding Leadership Medal

The NASA Outstanding Leadership Medal is awarded for notably outstanding leadership which has had a pronounced effect upon the aerospace technological or administrative programs of NASA.

1961	Edward R. Sharp
	Henry J. E. Reid
	Abe Silverstein
1962	Paul F. Bikle
	Hartley A. Soulé
	George B. Graves, Jr.
	Maxime A. Faget
	George M. Low
	John W. Townsend, Jr.
1963	Morton J. Stoller
	Maj. Gen. Leighton I. Davis (USAF)
	Kenneth S. Kleinknecht
	Christopher C. Kraft, Jr.
	G. Merritt Preston
	Floyd L. Thompson
	D. Brainerd Holmes
	Charles J. Donlan
	Walter Haeussermann
	William A. Mrazek
	John A. Johnson
1964	De E. Beeler
	Col. Robert P. Young (USA)
	Walter L. Lingle
	Wernher von Braun
	Kurt Debus
	Harry J. Goett
1965	Lt. Gen. Walter K. Wilson, Jr. (USA)
	Charles W. Mathews
	Oran W. Nicks
	Bruce T. Lundin
	Smith J. DeFrance
1966	Earl D. Hilburn
	John D. Young
	Oscar W. Schey
	John F. Clark
	Edgar M. Cortright
	Robert L. Krieger
	George J. Vecchietti
	Harold B. Finger
	Harry H. Gorman
	Edmund F. O'Connor
	Eberhard F. M. Rees
	Hermann K. Weidner
	Robert F. Thompson
	John J. Williams
	Maj. Gen. Vincent G. Huston (USAF)

Public Service Award

1963	Jack N. James
	Robert J. Parks
	John F. Yardley
1964	Bernie P. Miller
	Harris M. Schurmeier
	Allen E. Wolfe
1965	Daniel Klute (posthumously)
1966	Grant L. Hansen
	John F. Yardley
	Bastian Hello
	Bernhard A. Hohmann
	Walter D. Smith
	Walter F. Burke
	Louis D. Wilson
	Lawrence A. Smith
	William B. Bergen
	Jack L. Bowers
	George M. Bunker
	Brig. Gen. Paul T. Cooper (USAF)
	Daniel J. Haughton
	Roger Lewis
1966	James S. McDonnell, Jr.
	R. I. McKenzie
	L. Eugene Root
	David S. Lewis
1967	Richard Cottrell
	Paul P. Datner
	William Feldman
	Robert J. Helberg
	Robert L. Roderick
	Mark Sasso
1968	No award given

Superior Achievement Award

The NASA Superior Achievement Award is presented in recognition of a meritorious achievement which does not fall within the scope of other NASA awards. It is granted to an individual for an outstanding contribution or achievement which is sufficiently above normal work standards to warrant special recognition or which has resulted in specifically identifiable or monetary benefits to the Government.

1966
Arthur W. Vogeley
Richard J. Allen
LeRoy E. Day
John A. Edwards
Eldon W. Hall
Vearl N. Huff
Anthony L. Liccardi
William A. Summerfelt

B. Awards Granted Under Section 306 of the National Aeronautics and Space Administration Act of 1958

Section 306 of the National Aeronautics and Space Act of 1958 (42 U.S.C. 2458) authorized the Administrator of NASA, upon recommendation of the NASA Inventions and Contributions Board, to make monetary awards not exceeding $100 000 for any scientific or technical contribution which has significant value in the conduct of aeronautical and space activities. Awards exceeding $100 000 must be reported to the appropriate committees of the Congress and if the Congress takes no action or does not veto the proposed award, it may be made.

	Inventor	Contribution	Employer	Amount
1960	Frank T. McClure	Satellite Doppler navigation system	Applied Physics Laboratory, Johns Hopkins University	$3 000
1961	William J. O'Sullivan, Jr.	Erectible self-supporting space vehicle	Langley Research Center	5 000
1962	Emedio M. Bracalente Ferdinand C. Woolson	Ablation rate meter	Langley Research Center	2 000
	Andre J. Meyer, Jr.	Vehicle parachute and equipment jettison system	Manned Spacecraft Center	1 000
	Maxime A. Faget	Emergency ejection device	Manned Spacecraft Center	1 500
	Andre J Meyer, Jr. Maxime A. Faget William M. Bland, Jr. Jack C. Heberlig	Survival couch	Manned Spacecraft Center	2 100
	Maxime A. Faget Andre J. Meyer, Jr. R. G. Chilton W. S. Blanchard, Jr. A. B. Kehlet J. B. Hammack C. C. Johnson, Jr.	Space capsule	Manned Spacecraft Center	4 200
1963	Robert L. Trimpi	Expansion tube for hypervelocity	Langley Research Center	3 000
	Charles H. McLellan	Wedge tails for hypersonic aircraft	Langley Research Center	2 000
	Harold R. Kaufman	Ion rocket	Lewis Research Center	4 000

	Inventor	Contribution	Employer	Amount
	Conrad Josias	Bipolar Logarithmic current-to-voltage transducer	Jet Propulsion Laboratory	1 000
	James D. Acord Howard C. Vivian	Space vehicle attitude control	Jet Propulsion Laboratory	1 000
	Francis Rogallo Mrs. F. Rogallo	Flexible wing (kite)	Langley Research Center	35 000
	William J. Alford, Jr. Edward C. Polhamus	Variable-sweep-wing configuration	Langley Research Center	2 000
	Thomas A. Toll	Variable-sweep-wing supersonic aircraft	Langley Research Center	600
	Robert V. Hess	Hall-current plasma accelerator	Langley Research Center	1 200
	Curt P. Herold	Multiple quick disconnector	Marshall Space Flight Center	1 000
	Walter K. Victor Eberhardt Rechtin	Space communication system	Jet Propulsion Laboratory	5 000
	Andrew J. Kubica Noah S. Davis	Decomposition unit	Food Machinery and Chemical Corp.	1 500
1964	Robert C. Baumann Leopold Winkler	Spin adjusting mechanism	Goddard Space Flight Center	2 000
	William W. Smith Bruce W. Schmitz	Trajectory-correction propulsion system	Jet Propulsion Laboratory	1 000
	William R. Cherry Joseph Mandelkorn	Solar cell for radiation environment	Goddard Space Flight Center/Lewis Research Center	6 000
	John F. Meyer	Low-speed time multiplexing	Jet Propulsion Laboratory	1 300
	Gerald W. Meisenholder James D. Acord Howard C. Vivian Louis F. Schmidt	Sensing devices	Jet Propulsion Laboratory	1 600

	Inventor	Contribution	Employer	Amount
	Adrien E. Anderson Woodrow L. Cook James C. Daugherty J. Lloyd Jones, Jr. David G. Koenig	Commercial air transport	Ames Research Center	1 000
	Alfred J. Eggers, Jr. Clarence A. Syvertson George G. Edwards George C. Kenyon	Flight craft	Ames Research Center	1 000
1965	Casimir F. Kubik	Heat insulator	North American Aviation, Inc.	1 000
	Howard A. Stine Charles E. Shepard Velvin R. Watson	Electric apparatus	Ames Research Center	2 500
1966	Howard J. Robbins Zbiggie E. Zeebrowski	Attitude-control system for sounding rockets	Aerojet-General Corp.	1 000
	Manfred E. Kuebler	Nutation damper for satellites	Marshall Space Flight Center	1 500
	Paul A. Jensen	Low-noise, single-aperture, multimode monopulse antenna feed system	Hughes Aircraft Co.	1 200
	John M. Thole Wallace S. Kreisman Robert M. Chapman	Inflation system for balloon satellites	Goddard Space Flight Center/ Geophysics Corp.	1 000
	G. Richard Blair	Inorganic thermal control pigment	Hughes Aircraft Co.	1 000
	John C. McFall, Jr. Ray W. Lovelady	Underwater location system	Langley Research Center	1 500
	Kenneth A. Ruddock Robert C. Rempel	Three-component optically pumped magnetometer	Spectra Physics, Inc.	1 000
	Charles R. Peek Lewis E. Boodley	Connector strips-positive, negative end and "T" tabs	Astro-Electronics Div., Radio Corp. of America	1 000
	Robert K. Yasuri	Solar cell submodule	Jet Propulsion Laboratory	1 000

	Inventor	Contribution	Employer	Amount
	Warren E. Armstrong Donald S. LaFrance Carroll Z. Morgan Lloyd B. Ryland Hervey H. Voge	Catalyst for monopropellant decomposition of hydrazine	Shell Development Co.	3 000
1967	Joseph A. Goodrich Kenneth T. Ingham	Locking device for turbine rotor blades	North American Aviation, Inc.	1 200
	Richard C. Turner	Thermo couple assembly	Jet Propulsion Laboratory	1 000
	Richard A. McKay	Temperature control system for circulating fluids	Jet Propulsion Laboratory	1 000
	John B. Schutt Charles M. Shai	Alkali-metal silicate protective coating	Goddard Space Flight Center/ Electro Mechanical Research, Inc.	1 500
	Robert A. Jones James L. Hunt	Technique for quantitative measurement of aerodynamic heat transfer to supersonic wind	Langley Research Center	2 600
	Thomas E. Cowell Ira B. Madison	Aerodynamic nozzle spikes	Rocket Dynamics Div., North American Rockwell	800
	Irwin Baker	Constant life device	Hughes Aircraft Corp.	1 400
1968[a]	Clayton Loyd John R. Rasquin Hubert E. Smith Charles D. Stocks	Precision electronic control for orbital tube flaring machines	Marshall Space Flight Center	500
	Helmut G. L. Krause	Theory of a refined earth figure model and theory of a refined earth	Marshall Space Flight Center	500

Inventor	Contribution	Employer	Amount
	figure model with applications		
Daniel W. Gates Gene A. Zerlaut Frederick O. Rogers	Synthesis of zinc titanate pigment and coatings containing the same	Marshall Space Flight Center/IIT Research Institute	300
Wade McGee	Sprayable birefringent coating	Lockheed-Georgia Co.	100
Fred T. Humphrey Leon P. Stone David L. Johansen	Articulated multiple couch assembly	Weber Aircraft	100
David Cohen Samuel E. Stone	Fluid-handling system	Whirlpool Corp.	100
Joseph C. Heindl Robert J. Belanger	Fluid lubricant system	TRW Systems Inc.	250
George J. Zellner	Gas-cooled high-temperature thermocouple	Westinghouse Electric Co.	50
Walter P. Poschenrieder James A. R. Samson Peter Warneck	Analytical photoionization mass spectrometer	GCA Corp.	150
David J. McHaffie	Extensible cable support	North American Rockwell Corp.	50
Charles J. Taylor	High-resolution developing of photosensitive resists	Westinghouse Electric Co.	500
George J. Gilbert	Method and apparatus for ballasting high-frequency transistors	Radio Corp. of America	400
Billy D. Babb	Method and apparatus for cryogenic wire	Hayes International Corp.	400
David W. Passell	Decoder/actuator device	Jet Propulsion Laboratory	50
Charles T. Stelzreid Donald L. Mullen	Broadband microwave	Jet Propulsion Laboratory	100

Inventor	Contribution	Employer	Amount
	waveguide window		
Robin A. Winkelstein	Noninterruptable digital counting system	Jet Propulsion Laboratory	700
Alan R. Johnston	Polarimeter for transient measurement	Jet Propulsion Laboratory	1 400
Franklin L. Murphy	Bimetallic power-controlled actuator	Jet Propulsion Laboratory	500
James M. Kendall, Sr. Joseph A. Plamondon, Jr.	Absolute cavity radiometer	Jet Propulsion Laboratory	1 100

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[a] Through June 30.

C. Miscellaneous Awards to NASA Personnel

American Society of Mechanical Engineers Man of the Year Award

Not an official award, the ASME Man of the Year Award was given for the first time in 1967. It is administered by the Metropolitan Section of the American Society of Mechanical Engineers and is presented for "outstanding achievement in mechanical engineering."

1967 Wernher von Braun, MSFC

Federal Woman's Award

The Federal Woman's Award is presented annually to six women for "outstanding ability and achievement in an executive, professional, scientific, or technical position in Government."

1962	Nancy Grace Roman, NASA Hq.
1963	Eleanor C. Pressly, GSFC
1964	Evelyn Anderson, ARC
1966	Jocelyn R. Gill, MSC

Arthur S. Flemming Award

Administered by the District of Columbia Junior Chamber of Commerce in cooperation with the Chesapeake and Potomac Telephone Company, the Potomac Electric Power Company, and the Washington Gas Light Company, the Arthur S. Flemming Award is given annually "to outstanding young men in Federal Government in scientific or technical administrative or executive fields."

1959	Maxime A. Faget, LaRC
1960	Wolfgang E. Moekel, LeRC
	Joseph W. Siry, GSFC
1961	Bernard Lubarsky, LeRC
1962	Geroge M. Low, NASA Hq.
	Edgar M. Cortright, Jr., NASA Hq.
1963	John W. Townsend, Jr., GSFC
	Christopher C. Kraft, Jr., MSC
1964	Wesley J. Hjornevik, MSC
	Leonard Jaffe, NASA Hq.
	Robert Jastrow, GSFC
	Joseph F. Shea, MSC
1965	Wilmot N. Hess, GSFC
1967	John D. Hodge, MSC
	George F. Pezdirtz, ARC
1968	James J. Kramer, LeRC
	Norman F. Ness, GSFC

The National Civil Service League Career Service Award

This award is given for exceptional competence and sustained superior performance of career employees with 10 or more years of Federal service. It is given to strengthen public service by bringing national recognition to significant careers in the Federal service.

1958	Hugh L. Dryden, NASA Hq.	1964	Smith J. DeFrance, ARC
1960	Eugene S. Love, LaRC	1965	Homer E. Newell, NASA Hq.
1962	Abe Silverstein, LeRC	1967	Floyd L. Thompson, LaRC

National Medal of Science

Estab[illegible]ed in 1959 by Congress, this award was first presented in 1963. Its purpose is to h[illegible]dividuals who, in the judgment of the President, "are deserving of special recogniti[illegible]reason of their outstanding contributions to knowledge in the physical, biological, mathematical, or engineering sciences." The medal is presented annually and is the Federal Government's highest award in these fields of endeavor.

1965	Hugh L. Dryden (posthumously)

2. Professional Associations and Societies

A. Aerospace Medical Association

Louis H. Bauer Founder's Award

Established in 1960 to honor the founder of the Aerospace Medical Association, this award is given annually for the most significant contribution to space medicine. The honorarium is $500.

1961	Lt. Col. Stanley C. White (USAF, MC)
1962	Brig. Gen. Don D. Flickinger (USAF, MC)
1963	Col. Paul A. Campbell (USAF, MC)
1964	Col. William K. Douglas (USAF, MC)
1965	Hubertus Strughold, M.D.
1966	Charles A. Berry, M.D.
1967	R/Adm Frank B. Voris (USN, MC)
1968	James N. Waggoner, M.D.

Walter M. Boothby Award

Established in 1961 in memory of Dr. Walter M. Boothby, the award is given annually for outstanding research directed toward the promotion of health and prevention of disease in professional airline pilots. The honorarium is $1000.

1961	John E. Smith, M.D.
1962	Ross A. McFarland
1963	Jan H. Tillisch, M.D.
1964	Louis R. Krasno, M.D.
1965	Earl T. Carter, M.D.
1966	Stanley R. Mohler, M.D.
1967	G. Earle Wight, M.D.
1968	Charles R. Harper, M.D.

Howard K. Edwards Award

Established in 1961 in memory of Dr. Howard K. Edwards, this award is presented annually for the outstanding practice of clinical aviation medicine pertaining to professional airline pilots. The honorarium is $1000.

1961	George J. Kidera, M.D.
1962	Otis B. Schreuder, M.D.
1963	Ludwig G. Lederer, M.D.
1964	Andre Allard, M.D.
1965	John E. Smith, M.D.
1966	Charles C. Gullett, M.D.
1967	George F. Catlett, M.D.
1968	Peter B. Siegel, M.D.

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Eric Liljencrantz Award

The award was established in 1957 in memory of Cdr. Eric Liljencrantz (USN, MC), who worked in aviation medicine until his death in an airplane accident in 1942. It is given for the best paper on basic research in the problems of acceleration and altitude. The honorarium is $500.

1958	Brig. Gen Victor A. Byrnes (USAF, MC, Ret.)	1963	Earl W. Wood. M.D.
1959	Capt. Edward L. Beckman (USN, MC)	1964	Capt. Ralph L. Christy (USN, MC)
1960	James D. Hardy	1965	David M. Clark
1961	Capt. Ashton Graybiel (USN, MC)	1966	Henning von Gierke
1962	Wilbur R. Franks, M.D.	1967	Charles F. Gell, M.D.
		1968	Edward J. Baldes

Raymond F. Longacre Award

Established in 1947 to honor the memory of Maj. Raymond F. Longacre (USA), this award is given annually for outstanding achievement in the psychological and psychiatric aspects of aerospace medicine. The honorarium is $500.

1958	Col. Harry G. Moseley (USAF, MC)	1964	Frederick H. Hohles, M.D.
1959	Capt. George E. Russ (USAF, MC)	1965	Anchard F. Zeller
1960	Brant Clark	1966	Richard Trumbull
1961	Capt. Philip B. Phillips (USN, MC)	1967	Col. Don E. Flinn (USAF, MC)
1962	George T. Hauty	1968	Frederick E. Guedry
1963	Henry A. Imus		

Theodore C. Lyster Award

This award was established in 1947 to honor the memory of Brig. Gen. Theodore C. Lyster, first Chief Surgeon, Aviation Section, U.S. Army Signal Corps. It is given for outstanding achievement in the general field of aerospace medicine. The honorarium is $500.

1958	Hubertus Strughold, M.D.	1964	William Randolph Lovelace II, M.D.
1959	Capt. Clifford P. Phoebus (USN, MC)	1965	William J. Kennard, M.D.
1960	Air Commodore A. A. G. Corbet (RCAF)	1966	Brig. Gen. Eugene G. Reinartz (USAF, Ret.)
1961	Air Commodore William K. Stewart (RAF)	1967	Brig. Gen. John M. Talbot (USAF, MC)
1962	Robert J. Benford, M.D.	1968	Jan H. Tillishch, M.D.
1963	Maj. Gen. M. Samuel White (USAF, MC)		

Harry G. Moseley Award

Established in 1961 to honor the memory of Col. Harry G. Moseley, this award is given annually for the most outstanding contribution to flight safety. The honorarium is $500.

1961	Capt. Carl E. Wilbur (USN, MC)
1962	Col. F. M. Townsend (USAF, MC)
1963	Brig. Gen. Kenneth E. Pletcher (USAF, MC)
1964	Capt. W. Harley Davidson (USAF, MC)
1965	Capt. Richard E. Leuhrs (USN, MC)
1966	Capt. Roland A. Bosee (USN, MC)
1967	Maj. Richard M. Chubb (USAF, MC)
1968	John J. Swearingen

Arnold D. Tuttle Award

Established in 1952, this award is given annually for original research that has made the most significant contribution toward the solution of a challenging problem in aerospace medicine. The honorarium is $500.

1958	Siegfried J. Gerathewohl
1959	Lawrence E. Lamb, M.D.
1960	Hermann J. Schaefer
1961	Lt. Col. Charles A. Berry (USAF, MC)
1962	Clayton S. White, M.D.
1963	Charles I. Barron, M.D.
1964	Vincent M. Downey, M.D.
1965	Capt. Ashton Graybiel (USN, MC)
1966	Lt. Col. James F. Culver (USAF, MC)
1967	Billy E. Welch
1968	Dietrich E. Beischer, M.D.

B. Air Force Association

H. H. Arnold Trophy

This trophy is awarded to aerospace's "Man of the Year" for the most outstanding contribution to the field of aerospace activity.

1958	Maj. Gen. Bernard A. Schriever (USAF)
1959	Gen. Thomas S. Power (USAF)
1960	Gen. Thomas D. White (USAF)
1961	Lyle S. Garlock
1962	A. C. Dickieson John R. Pierce
1963	363rd Tactical Reconnaissance Wing, TAC 4080th Strategic Wing, SAC
1964	Gen. Curtis E. LeMay (USAF)
1965	2nd Air Division, PACAF, USAF
1966	8th, 12th, 355th, 366th, and 388th Tactical Fighter Wing 432d and 460th Tactical Reconnaissance Wing
1967	William W. Momyer
1968	Col. Frank Borman (USAF) Capt. James A. Lovell, Jr. (USN) Lt. Col. William A. Anders (USAF)

Theodore von Kármán Trophy

Established in 1948, this trophy was originally named the "Science Trophy," but was renamed in honor of the late Theodore von Kármán. It is awarded for distinguished service in the field of aerospace science.

1958	H. Julian Allen, ARC
1959	W. Randolph Lovelace II, M.D. Brig. Gen. Don D. Flickinger (USAF)
1960	Louis N. Ridenour, Jr. (posthumously)
1961	Allen F. Donovan
1962	Charles H. Townes
1963	Maj. Clarence L. "Kelly" Johnson (USAF)
1964	Maj. Clarence L. "Kelly" Johnson (USAF)
1965	Capt. Robert M. Silva (USAF)
1966	6555th Aerospace Test Wing, AFSC
1967	Alterio Gallerani
1968	Lt. Col. Harry F. Rizzo (USAF)

David C. Schilling Trophy

Founded in 1948 as the "Flight Trophy," this award was renamed in 1957 in honor of the late Col. David C. Schilling. It is awarded for distinguished service in the field of flight.

1958	Capt. Iven C. Kincheloe, Jr. (USAF) (posthumously)
1959	Tactical Air Command, USAF
1960	Lt. Gen. Elwood R. Quesada (USAF, Ret.)
1961	Maj. Robert M. White (USAF) A. Scott Crossfield Joseph A. Walker
1962	Maj. Robert M. White (USAF)
1963	Maj. L. Gordon Cooper, Jr. (USAF)
1964	Maj. Sidney J. Kubesch (USAF)
1965	Lt. Col. Frank Borman (USAF)
1966	Maj. Hallett P. Marston (USAF)
1967	Col. Robin Olds (USAF)
1968	Capt. Albert R. Kaiser (USAF)

Hoyt S. Vandenberg Trophy

Established in 1948, this trophy was originally named the "Air Education Trophy," but was renamed in 1954 in honor of the late Gen. Hoyt S. Vandenberg. It is awarded for distinguished service in the field of aerospace education.

1958	Ralph J. Cordiner
1959	Frank E. Sorenson
1960	Wayne O. Reed
1961	Charles H. Boehm
1962	Lindley J. Stiles
1963	Brig. Gen. Robert F. McDermott (USAF)
1964	Aerospace Presentations Team
1965	Brig. Gen. William C. Lindley (USAF)
1966	B. F. Skinner
1967	No award given
1968	Marion B. Folsom

Gill Robb Wilson Trophy

This trophy is awarded for distinguished service to aerospace in the field of arts and letters.

1958	Air Photographic and Charting Service, MATS
1959	James F. Sunderman
1960	Walter Lippman
1961	Orvil A. Anderson Albert Simpson
1962	Bob Considine
1963	George C. Bales
1964	Mark S. Watson
1965	Elton C. Fay
1966	Society of Illustrators of New York City, Los Angeles, and San Francisco
1967	Robert F. Engel
1968	Edward C. Welsh

C. American Astronautical Society

Flight Achievement Award

Established in 1958, this award is given annually to persons who have contributed most to the advancement of manned space flight.

1958	Capt. Iven C. Kincheloe, Jr. (USAF) (posthumously)
1959	A. Scott Crossfield
1960	No award given
1961	Lt. Cdr. Alan B. Shepard, Jr. (USN) Capt. Virgil I. Grissom (USAF)
1962	Lt. Col. John H. Glenn, Jr. (USMC)
1963	Maj. L. Gordon Cooper, Jr. (USAF)
1964	Charles A. Lindbergh
1965	Lt. Col. Frank Borman (USAF) Cdr. James A. Lovell, Jr. (USN) Capt. Walter M. Schirra, Jr. (USN) Maj. Thomas P. Stafford (USAF)
1966	Lt. Cdr. Charles Conrad, Jr. (USN) Lt. Cdr. Richard F. Gordon, Jr. (USN)
1967	Lt. Col. Virgil I. Grissom (USAF) (posthumously) Lt. Col. Edward H. White II (USAF) (posthumously) Lt. Cdr. Roger B. Chaffee (USN) (posthumously)
1968	Col. Frank Borman (USAF) Capt. James A. Lovell, Jr. (USN) Lt. Col. William A. Anders (USAF)

Melbourne W. Boynton Award

This award, established in 1957, is presented annually for outstanding contributions to "a physician who has performed research contributing with distinction to the safety of space flight."

1958	Capt. Charles F. Gell (USN, MC)	1963	Hubertus Strughold, M.D.
1959	Lt. Col. Stanley C. White (USAF)	1964	No award given
1960	Brig. Gen. Don D. Flickinger (USAF, MC)	1965	Charles A. Berry, M.D.
1961	Capt. Ashton Graybiel (USN, MC)	1966	Col. William K. Douglas (USAF, MC)
1962	William Randolph Lovelace II, M.D.	1967	Paul A. Campbell
		1968	William M. Helvey, M.D.

Space Flight Award

Established in 1955, this award is given annually as an acknowledgement of outstanding efforts and achievements in the advancement of space flight and space science.

1958	James A. Van Allen	1965	Hugh L. Dryden (posthumously)
1959	No award given	1966	Robert R. Gilruth
1960	Homer E. Newell	1967	Kurt Debus
1961	Fred L. Whipple		William H. Pickering
1962	Charles Stark Draper	1968	George M. Low
1963	No award given		George E. Mueller
1964	No award given		

Victor A. Prather Award

This award was established in 1962 to honor Lt. Cdr. Victor A. Prather (USN), who lost his life during a strato-lab balloon flight in 1961. The award is given to researchers and engineers in the field of extravehicular protection in space.

1962	Cdr. Malcolm Davis Ross (USNR)	1966	No award given
1963	Col. Charles Yeager (USAF)	1967	No award given
1964	No award given	1968	Edward L. Hays
1965	Richard S. Johnston		James V. Correale

W. Randolph Lovelace II Award

This award, honoring the last NASA Director of Space Medicine, is not presented annually, but "on a timely basis when it is felt that a particular individual merits recognition for sustained contributions to space technology."

1965	Jeannette Ridlon Piccard	1967	Robert Truax
1966	Robert Morris Page	1968	Arthur L. H. Roudolph

Lloyd V. Berkner Space Utilization Award

This award is presented for outstanding contributions to the commercial utilization of space technology.

1967	Austin N. Stanton	1968	Joseph Charyk, Comsat Corp. Alfred M. Mayo

D. American Geophysical Union

John Adam Fleming Award

This award was presented for the first time in 1962; it commemorates Dr. Fleming (1877-1956), a pioneer in the development of the broad field of geophysics and director of much of the magnetic and electric survey work of the earth in the first half of the twentieth century. The award is given primarily "for original research illuminating fundamental aspects of aeronomy, and other closely related branches of science."

1962	Lloyd V. Berkner	1966	Scott E. Forbush
1963	James A. Van Allen	1967	Ernest Harry Vestine
1964	Edward O. Hulburt	1968	Eugene N. Parker
1965	Norman F. Ness		

James B. Macelwane Award

This award is presented in recognition of significant contributions to the geophysical sciences by a young scientist of outstanding ability.

1962	James N. Brune	1966	Don L. Anderson
1963	Alexander J. Dessler	1967	Manik Talwani
1964	Klaus F. Hasselmann	1968	Michael B. McElroy
1965	Gordon J. F. MacDonald		

William Bowie Medal

This award is presented for outstanding contributions to fundamental geophysics and for unselfish cooperation in research.

1958	Johannes Theodoor Thijsse
1959	Walter Maurice Elsasser
1960	Francis Birch
1961	Keith Edward Bullen
1962	Sidney Chapman
1963	Merle Anthony Tuve
1964	Julius Bartels
1965	Hugo Benioff
1966	Louis B. Slichter
1967	Lloyd V. Berkner
1968	Roger Revelle

E. American Helicopter Society

Grover E. Bell Award

Established to honor an aviation pioneer, this award is presented "for the purpose of fostering and encouraging research and experimentation in the important and relatively new field of helicopter development to the person or persons making an outstanding contribution to helicopter developments during the preceding calendar year in the United States."

1958	Lee L. Douglas
1959	Igor I. Sikorsky
1960	Combat Development Office, U.S. Army Aviation School, Fort Rucker, Alabama
1961	Engineering Organization, Sikorsky Aircraft Div., United Aircraft Corp.
1962	Army Aviation Center, Fort Rucker, Alabama
1963	11th Air Assault Div., U.S. Army, Fort Benning, Georgia
1964	No award given
1965	Paul J. Carpenter
1966	Air Rescue and Recovery Service, Military Airlift Command, USAF
1967	Edwin J. Ducayet and the Huey Cobra Team
1968	Sikorsky Aircraft and the flying crane concept

Frederick L. Feinberg Award

Established in 1959, this award honors Frederick L. Feinberg (1922-1958), an outstanding helicopter test pilot. It is given annually "to the helicopter pilot who accomplished the outstanding achievement"—rescue, flight and test development of new aircraft, or general high level of performance in operational flying—in the preceding calendar year. The honorarium is $200.

1960	Maj. William G. Davis (USAF) Capt. Walter J. Hodgson (USAF)	1964	Winford Alan Newton (posthumously)
1961	Link Luckett	1965	Col. George P. Seneff (USAF)
1962	Lt. Col. Francis M. Carney (USAF)	1966	Delford M. Smith
1963	Lt. Robert W. Grafton (USN)	1967	Maj. Robert G. Ferry (USAF)
	Capt. Louis K. Keck (USMC)	1968	Capt. Jerome R. Daly (USA)

Paul E. Haueter Memorial Award

This award is presented "for significant contributions to the development of Vertical-Takeoff-and-Landing aircraft other than helicopters." The award was established by friends of Paul E. Haueter (1923-1964), an aeronautical engineer.

1966	The XC-142A Tri-Service V/STOL Aircraft Program LTV Aerospace Corporation, Prime Contractor	1967	Hawker Siddeley Aviation, Hawker Siddeley Group Ltd.
		1968	John P. Campbell

Alexander Klemin Award

Established in 1951 in honor of the memory of the late Dr. Alexander Klemin—eminent aeronautical engineer, educator, author, and pioneer of rotary-wing aeronautics—the award is given each year for "engineering, design, and invention in the field of rotary-wing aircraft."

1958	Frederich L. von Doblhoff	1964	Kurt H. Hohenemser
1959	Robert L. Lichten	1965	Elliot Daland
1960	V Keith Putnam	1966	Iven H. Culver
1961	Leon L. Douglas	1967	Anselm Franz
1962	Brig. Gen. Robert R. Williams (USA)	1968	Rene H. Miller
1963	Frederick B. Gustafson		

Captain William J. Kossler Award

Established to honor the memory of Capt. William J. Kossler (1896-1945)—U.S. Coast Guard aviator, aeronautical engineer, and early advocate of helicopters for Coast Guard operations—this award is given "for greatest achievement in practical application or operation of rotary-wing aircraft, the value of which has been demonstrated by actual service during the preceding year."

1958	Transportation Aircraft Test and Supply Activity (USA)
1959	New York Airways, Inc.
1960	Col. Victor A. Armstrong (USMC) Col. William A. Howell (USA)
1961	56th Medical Platoon 57th Medical Platoon
1962	Air Rescue Service, Military Air Transport Service, Scott AFB, Illinois
1963	U.S. Army Tactical Mobility Requirements Review Board
1964	Brig. Gen. John J. Tolson (USA)
1965	To individuals and organizations, military and civilian, who participated in the numerous rescues and supply and resupply missions during the disastrous floods in the Northwestern United States in December 1964.
1966	Maj. Gen. Harry W. O. Kinnard (USA)
1967	Maj. Gen. Keith B. McCutcheon (USMC)
1968	The individuals in the Armed Services in Southeast Asia, who, by innovation and imaginative operational techniques, have made significant contributions to the effectiveness of the helicopter.

Igor I. Sikorsky International Trophy

This award is offered "in recognition of outstanding achievement in the advancement of the helicopter art by the establishment of an official world record."

1961	Mihil L. Mil Design Team, U.S.S.R.
1962	Sikorsky Aircraft Division, United Aircraft Corporation
1963	Sud Aviation, France
1964	No award given
1965	Sikorsky Aircraft Division, United Aircraft Corporation
1966	Hughes Tool Company, Aircraft Division
1967	No award given
1968	No award given

F. American Institute of Aeronautics and Astronautics

On February 1, 1963, the American Rocket Society and the Institute of Aerospace Sciences (changed October 27, 1960, from the Institute of Aeronautical Sciences) merged to become the American Institute of Aeronautics and Astronautics (AIAA).

AIAA Aerospace Communications Award

Established in 1968, this award honors the late Don Williams, a pioneer in the development and design of synchronous communications satellites. It was presented for the first time in 1968.

1968	Donald D. Williams	Harold A. Rosen

Octave Chanute Award

Established by the Institute of Aeronautical Sciences in 1939 in honor of Octave Chanute, American aeronautical pioneer, this award is given "for a notable contribution made by a pilot to the aerospace sciences." It carries a $500 honorarium.

1958	A. Scott Crossfield	1964	Fred J. Drinkwater III
1959	John P. Reeder		Robert C. Innis
1960	Joseph T. Tymczyszyn	1965	Alvin S. White
1961	Joseph A. Walker	1966	Donald F. McKusker
1962	Neil A. Armstrong		John L. Swigert, Jr.
1963	Col. E. J. Bechtold (USA, Ret.)	1967	Milton O. Thompson
		1968	Maj. William J. Knight (USAF)

De Florez Training Award

The De Florez Training Award was presented for the first time in 1965 and is given to an individual responsible for an outstanding improvement in aerospace training. The award is named for the late Adm. Luis de Florez (USN), who did much to advance the use of simulators in the training of pilots. The honorarium is $500.

1965	Lloyd L. Kelly	1967	Edwin A. Link
1966	Warren J. North	1968	Joseph LaRussa

Goddard Award

Established in 1963, this award succeeds the Robert H. Goddard Memorial Award established by the American Rocket Society in 1947 in honor of the rocket pioneer. It is presented for outstanding contributions "in the engineering science of propulsion or energy conversion." The award carries a $10 000 honorarium.

1958	Richard B. Canright
1959	Samuel K. Hoffman
1960	Theodore von Kármán
1961	Wernher von Braun
1962	Robert R. Gilruth
1963	No award given
1964	Hugh L. Dryden
1965	Sir Frank Whittle
1966	Hans J. P. von Ohain
	A. W. Blackman
	George D. Lewis
1967	Robert O. Bullock
	Irving A. Johnsen
	Seymour Lieblein
1968	Donald C. Berkey
	Ernest C. Simpson
	James E. Worsham

Haley Astronautics Award

The Astronautics Award was established by the American Rocket Society in 1954 and renamed in 1966 to honor the late Andrew G. Haley. It is presented annually for outstanding contributions to the advancement of space flight and carries a $500 honorarium.

1958	Capt. Iven C. Kincheloe, Jr. (USAF)
1959	Walter R. Dornberger
1960	A. Scott Crossfield
1961	Lt. Cdr. Alan B. Shepard, Jr. (USN)
1962	Lt. Col. John H. Glenn, Jr. (USMC)
1963	Lt. Cdr. Walter M. Schirra, Jr. (USN)
	Maj. L. Gordon Cooper, Jr. (USAF)
1964	Walter C. Williams
1965	Brig. Gen. Joseph S. Bleymaier (USAF)
1966	Neil A. Armstrong
	Lt. Col. David R. Scott (USAF)
1967	Lt. Col. Edward H. White II (USAF) (posthumously)
1968	Lt. Col. Virgil I. Grissom (USAF) (posthumously)

Louis W. Hill Space Transportation Award

The Louis W. Hill Space Transportation Award, named for a transportation pioneer, is given for "significant contributions indicative of American enterprise and ingenuity in the art and science of space flights." The honorarium is $5000, or up to $10 000 for joint awards.

1958	Robert H. Goddard (posthumously)	1964	Hugh L. Dryden
1959	James A. Van Allen	1965	Wernher von Braun
1960	S. K. Hoffman Thomas E. Dixon	1966	W. Randolph Lovelace II, M.D. (posthumously)
1961	Robert R. Gilruth	1967	Abe Silverstein
1962	Charles Stark Draper	1968	W. H. Pickering
1963	Robert J. Parks Jack N. James		

John Jeffries Award

Established in 1940 by the Institute of Aeronautical Sciences, the John Jeffries Award is given for "outstanding contributions to the advancement of aeronautics through medical research." The award honors Dr. Jeffries (1744-1819), an American physician and balloonist who made the earliest recorded scientific observations from the air and participated in the first aerial crossing of the English Channel in 1785. The honorarium is $500.

1958	Hubertus Strughold, M.D.	1963	No award given
1959	Brig. Gen. Don D. Flickinger (USAF)	1964	Eugene Konecci
		1965	Col. William K. Douglas (USAF, MC)
1960	Capt. Joseph W. Kittinger, Jr. (USAF)	1966	Charles A. Berry, M.D.
		1967	Charles I. Barron, M.D.
1961	Capt. Ashton Graybiel (USN, MC)	1968	Loren D. Carlson
1962	James L. Goddard, M.D.		

Robert M. Losey Award

Established in 1940 by the Institute of the Aeronautical Sciences, this award honors Capt. Losey, a meteorological officer with the U.S. Army and the first officer in the service of the U.S. to die in World War II. It is given annually "in recognition of outstanding contributions to the science of meteorology as applied to aeronautics" and carries a $500 honorarium.

1958	Patrick D. McTaggart-Cowan	1964	Col. Robert C. Miller (USAF)
1959	Herbert Riehl	1965	George P. Cressman
1960	Thomas F. Malone	1966	David Atlas
1961	Arthur F. Merewether	1967	Elmar R. Reiter
1962	Jacob A. B. Bjerknes	1968	No award given
1963	No award given		

Mechanics and Control of Flight Award

The Mechanics and Control of Flight Award, given for the first time in 1967, is presented for "an outstanding recent technical or scientific contribution by an individual in the mechanics, guidance or control of flight in space or in the atmosphere." The honorarium is $500.

1967	Derek F. Lawden	1968	Robert V. Knox

G. Edward Pendray Award

Established in 1950 by the American Rocket Society in honor of one of its founders, the G. Edward Pendray Award is given annually for an outstanding contribution to aeronautics and astronautical literature. It carries a $500 honorarium.

1958	Homer E. Newell, Jr.	1964	Andrew G. Haley
1959	Ali B. Cambel	1965	Dinsmore Alter
1960	Luigi Crocco	1966	A. K. Oppenheim
1961	Krafft Ehricke	1967	Robert A. Gross
1962	Howard S. Seifert	1968	Arthur E. Bryson, Jr.
1963	No award given		

Sylvanus Albert Reed Award

Established in 1953 by the Institute of Aeronautical Sciences, the Sylvanus Albert Reed Award is named for the aircraft designer, who was a founder-member of IAS. It is presented annually "for a notable contribution to aeronautical engineering design for the aeronautical sciences, the beneficial influence of which is apparent on the development of practical aeronautics." The honorarium is $500.

1958	Victor E. Carbonara	1964	Abe Silverstein
1959	Karel J. Bossart	1965	Arthur E. Raymond
1960	John W. Becker	1966	Maj. Clarence L. Johnson (USAF)
1961	Alfred J. Eggers, Jr.	1967	Adolph Busemann
1962	Walter C. Williams	1968	William H. Cook
1963	No award given		

Dryden Research Lecture

Established in 1960 by the American Rocket Society, the Research Award was renamed the Dryden Research Lecture in 1967 in honor of the late Hugh L. Dryden. This traveling lecture award is "intended to emphasize the great importance of basic research to the Nation's program in aeronautics and astronautics, a salute to research scientists and engineers in American laboratories." The lecture carries a $1000 honorarium.

1961	James A. Van Allen	1965	Wallace D. Hayes
1962	A. Theodore Forrester	1966	Shao-chi Lin
1963	No award given	1967	Edward W. Price
1964	Henry M. Shuey	1968	Hans W. Liepmann

Space Science Award

Established in 1961 by the American Rocket Society and Bell Aerosystems Co., the Space Science Award is given "to a scientist who has distinguished himself through his achievements in investigation of the physics of atmospheres of celestial bodies and of the matter and fields existing in space." The honorarium is $500.

1962	John R. Winkler	1966	Francis S. Johnson
1963	No award given	1967	Robert B. Leighton
1964	Maj. Herbert Friedman (USA, Ret.)	1968	Kinsey A. Anderson
1965	Eugene N. Parker		

Lawrence B. Sperry Award

Established in 1936 by the Institute of Aeronautical Sciences, the award is named for a pioneer aviator and inventor who died in 1923 while attempting a flight across the English channel. It is given "for a notable contribution made by a young man to the advancement of aeronautics." The honorarium is $500.

1958	Robert G. Loewy	1964	Daniel M. Tellep
1959	James E. McCune	1965	Rodney C. Wingrove
1960	Robert B. Howell	1966	Capt. Joe H. Engle (USAF)
1961	Douglas G. Harvey	1967	Eugene F. Kranz
1962	Robert O. Piland	1968	Roy V. Harris, Jr.
1963	No award given		

von Kármán Lecture

Established in 1962 by the American Rocket Society, the von Kármán Lecture is given in honor of Theodore von Kármán, world famous authority on aerodynamics. The award carries a $1000 honorarium.

1962	Hugh L. Dryden
1963	No award given
1964	Arthur Kantrowitz
1965	Raymond L. Bisplinghoff
1966	Nicholas J. Hoff
1967	Lester Lees
1968	William B. Sears

Wright Brothers Lecture

The Wright Brothers Lecture commemorates the first powered flights made by Orville and Wilbur Wright at Kitty Hawk in 1903 and is presented for "great distinction in the aerospace sciences." The honorarium is $1000.

1958	Maurice Roy
1959	Alexander H. Flax
1960	A. W. Quick
1961	Robert Jastrow
1962	M. James Lighthill
1963	No award given
1964	George S. Schairer
1965	Gordon N. Patterson
1966	Charles Stark Draper
1967	Philippe Poisson-Quinton
1968	Charles W. Harper

James H. Wyld Propulsion Award

Established in 1948 by the American Rocket Society, the C. N. Hickman Award was renamed the Propulsion Award in 1952. The James H. Wyld Memorial Award, established in 1953 by the American Rocket Society, was merged in 1964 with the Propulsion Award to become the James H. Wyld Propulsion Award, given "for outstanding achievement in the development or application of rocket propulsion systems." The award, named for the developer of the regeneratively cooled rocket engine, carries a $500 honorarium.

Propulsion Award

1958	Barnet R. Adelman
1959	Ernest Roberts
1960	Ernst Stuhlinger
1961	Capt. Robert B. Young (USMC)
1962	Samuel K. Hoffman
1963	No award given
1964	David Altman

James H. Wyld Memorial Award

1958	Gen. Holger W. Toftoy
1959	Karel J. Bossart
1960	Robert L. Johnson
1961	Harrison A. Storms, Jr.
1962	V/Adm. William F. Raborn (USN)
1963	No award given
1964	Brig. Gen. Joseph S. Bleymaier (USAF)

James H. Wyld Propulsion Award

1965	Werner R. Kirchner
1966	Maurice J. Zucrow
1967	Adelbert O. Tischler
1968	Harold B. Finger

G. American Institute of Aeronautics and Astronautics (Alabama Section)

Hermann Oberth Medal

Established in 1959 by the American Rocket Society, the Hermann Oberth Medal is now administered by the AIAA (Alabama Section) and is given to "commemorate major accomplishments in the fields of science and engineering." This award, honoring rocket pioneer Herman Oberth (1894-) is limited to members or former members of the Alabama Section.

1959	Gen. John B. Medaris (USA)
1960	Gen. John A. Barclay (USA)
1961	Gen. H. W. Toftoy Wernher von Braun
1962	Ernst Stuhlinger
1963	Carl Hiemburg
1964	Hugh Taylor (posthumously)
1965	W. R. Lucas
1966	Hermann H. Koelle
1967	Maj. William C. Snoddy (USA, Ret.)

H. American Meteorological Society

Cleveland Abbe Award

This award, presented occasionally, is given for outstanding contributions to the progress of atmospheric science. The award honors Cleveland Abbe (1838-1916), the first American to make successful day-to-day predictions for a Government weather service.

1963	Lloyd V. Berkner
1964	Francis W. Reichelderfer
1965	Sverre Petterssen
1966	Alan T. Waterman
1967	Thomas F. Malone
1968	Robert M. White

Applied Meteorology Award

The award for Applied Meteorology is made to an individual for outstanding contributions to advance applied meteorology.

1959	Joseph J. George Carl-Gustaf Arvid Rossby (posthumously)
1960	Henry T. Harrison
1961	Robert D. Elliott
1962	Alfred H. Glenn
1963	Herbert C. S. Thom
1965	Loren W. Crow
1966	Eugene Bollay
1967	Wallace E. Howell
1968	E. Wendell Hewson

Bioclimatology Outstanding Achievement Award

Established in 1959, this award is given to an individual who has made outstanding contributions in the field of bioclimatology.

1960	Frederick Sargent II	1966	Frederick A. Brooks
1963	Konrad J. K. Buettner	1967	Paul E. Waggoner
1964	Helmut E. Landsberg	1968	No award given

Meisinger Award

This award honoring Clarence Leroy Meisinger, an aerologist acclaimed for his fundamental work in upper-air pressure computation, is given from time to time for outstanding research contributions by meteorologists under 35 years of age.

1959	Robert C. Fleagle	1963	Edward N. Lorenz
1960	Philip D. Thompson	1964	Richard J. Reed
	Norman A. Phillips	1965	Hans A. Panofsky
1961	Verner E. Suomi	1966	George W. Platzman
1962	Louis J. Battan	1967	Katsuyuki Ooyama
	Joanne Starr Malkus	1968	Richard S. Lindzen

Carl-Gustaf Rossby Research Medal

This award is presented "on the basis of outstanding contributions to man's understanding of the structure or behavior of the atmosphere." Until 1958 this award was called the Award for Extraordinary Scientific Achievement, but was renamed for Carl-Gustaf Rossby, whose contributions to the dynamic meteorology led to a better understanding of atmospheric motions and thermodynamics. It represents the highest honor the AMS can bestow upon an atmospheric scientist.

1960	J. Bjerknes	1964	Jule G. Charney
	Erik Palmén	1965	Arnt H. Eliassen
1961	Victor P. Starr	1966	Zdenek Sekera
1962	Bernhard Haurwitz	1967	Verner E. Suomi
1963	Harry Wexler (posthumously)	1968	Edward N. Lorenz

Sverdrup Gold Medal

This award, established in 1964 to honor the late Harald Ulrik Sverdrup, is granted to "researchers who make outstanding contributions to the scientific knowledge of interactions between the oceans and the atmosphere."

1964	Henry Stommel	1966	Walter H. Munk

I. American Society of Mechanical Engineers

John Fritz Medal

Established in 1902, in honor of a pioneer in the U.S. iron and steel industry, the John Fritz Medal is awarded annually "for notable scientific or industrial achievement without restriction on account of nationality or sex." The award is made jointly with four other national engineering societies.

1958	John R. Suman	1964	Gen. Lucius D. Clay (USA, Ret.)
1959	Mervin J. Kelly	1965	Frederick R. Kappel
1960	Gwilym A. Price	1966	Warren K. Lewis
1961	Stephen D. Bechtel	1967	Walker L. Cisler
1962	Crawford H. Greenewalt	1968	Igor I. Sikorsky
1963	Hugh L. Dryden		

Elmer A. Sperry Award

Established in 1955, the award commemorates "contributions to advancement of the art of transportation" by Elmer Ambrose Sperry (1860-1930). It is given in recognition of "a distinguished engineering contribution, which, through application, proved in actual service, has advanced the art of transportation whether by land, sea, or air." The award is sponsored jointly by ASME, three other engineering societies, and the American Institute of Aeronautics and Astronautics.

1958	Ferdinand Porsche (posthumously)
	Heinz Nordhoff
1959	Sir Geoffrey de Havilland
	Frank B. Halford
	Charles C. Walker
1960	Frederick Darcy Braddon
1961	Robert Gilmore Letourneau
1962	Lloyd J. Hibbard
1963	Earl A. Thompson
1964	Igor I. Sikorsky
	Michael E. Gluhareff
1965	Maynard L. Pennell
	Richard L. Rouzie
	John E. Steiner
	William H. Cook
	Richard L. Loesch, Jr.
1966	Hideo Shima
	Matsutaro Fujii
	Shigenari Oishi
1967	Edward R. Dye (posthumously)
	Hugh DeHaven
	Robert A. Wolf
1968	Christopher S. Cockerell
	Richard Stanton-Jones

Spirit of St. Louis Medal

Established in 1929, this award is given "for meritorious service in the advancement of aeronautics."

1958	George S. Schairer
1961	Samuel K. Hoffman
1962	Robert H. Widmer
1963	Frederick C. Crawford
1964	Robert R. Gilruth
1965	William H. Pickering
1966	Christopher C. Kraft, Jr.
1967	Ira G. Hedrick
1968	George S. Moore

American Society of Mechanical Engineers Medal

Established in 1920, the ASME Medal is awarded annually for "eminently distinguished engineering achievement."

1958	Wilbur H. Armacost
1959	Martin Frisch
1960	C. Richard Soderberg
1962	Philip Sporn
1963	Igor I. Sikorsky
1964	Alan Howard
1965	Johannes M. Burgers
1967	Mayo D. Hersey
1968	Samuel C. Collins

J. Army Aviation Association of America

Army Aviator of the Year Award

Established in 1959, this award is given for outstanding individual accomplishment in Army aviation.

1959	Capt. James T. Kerr	1964	Maj. Marquis D. Hilbert
1960	CWO Clifford V. Turvey	1965	Maj. Paul A. Bloomquist
1961	CWO Michael J. Madden	1966	Capt. James A. Scott III
1962	Capt. Leyburn W. Brockwell, Jr.	1967	CWO Jerome R. Daly
1963	Capt. Emmett F. Knight	1968	Capt. Robin K. Miller

James H. McClellan Aviation Safety Award

This award is given to officers, soldiers, or civilians who have made outstanding contributions to Army aviation safety.

1959	Maj. Arne H. Eliassen	1964	Col. Conrad L. Stansberry
1960	Col. John L. Inskeep	1965	Ralph B. Greenway
1961	No award given	1966	Gerard M. Bruggink
1962	Col. Spurgeon H. Neel, Jr.	1967	Capt. Gary F. Ramage
1963	Col. James F. Wells	1968	Francis P. McCourt

K. Arnold Air Society

General H. H. Arnold Trophy

Established in 1958, this trophy honors the late General Arnold (USAF), the first honorary national commander of the Arnold Air Society. It is awarded to a member of the USAF for "outstanding contributions to military aviation and aerospace progress."

1958	Lt. Col. David Simon (USAF)	1964	Gen. Curtis E. LeMay (USAF)
1959	Maj. Gen. Donald Yates (USAF)	1965	Gen. Thomas S. Power (USAF)
1960	Lt. Gen. Bernard A. Schriever (USAF)	1966	Maj. Gen. Robert R. Rowland (USAF)
1961	Gen. Thomas D. White (USAF)	1967	Gen. Howell M. Estes, Jr. (USAF)
1962	Maj. Robert White (USAF)	1968	Gen. John P. McConnell (USAF)
1963	Gen. Osmond J. Ritland (USAF)		

General Muir S. Fairchild Trophy

Established in 1963, this trophy is awarded to an educator for outstanding contributions to aerospace education.

1963	Clifford C. Furnas
1964	Lindley J. Stiles
1965	Wayne O. Reed
1966	W. Randolph Lovelace II (posthumously)
1967	Howard W. Johnson
1968	Maj. Gen. Leo F. Dusard, Jr. (USAF)

Paul T. Johns Trophy

Established in 1958 by the Arnold Air Society, this trophy honors the late Paul T. Johns, the first National Commander of the Arnold Air Society. It is awarded to a civilian for "outstanding contributions to aeronautics and astronautics."

1958	Krafft Ehricke
1959	Walter Cronkite
1960	James H. Straubel
1961	Simon Ramo
1962	Edward C. Welsh
1963	D. Brainerd Holmes
1964	Trevor Gardner (posthumously)
1965	John F. Loosbrock
1966	George Edward Haddaway
1967	Edwin A. Link
1968	Mike Monroney

John Fitzgerald Kennedy Trophy

Established in 1964, this trophy honors the late President Kennedy, an honorary member of the Arnold Air Society. It is awarded for "outstanding contributions to aerospace flight."

1964	Maj. L. Gordon Cooper, Jr. (USAF)
1965	Brig. Gen. Joseph S. Bleymaier (USAF)
1966	Lt. Col. Edward H. White II (USAF)
	Lt. Col. James A. McDivitt (USAF)
1967	Lt. Gen. Leighton I. Davis (USAF)
1968	Edward C. Welsh

General Hoyt S. Vandenberg Trophy

Established in 1963 by the Arnold Air Society, this trophy is awarded to a scientist for "outstanding scientific contributions to aerospace technology."

1963	John R. Pierce
	Alton C. Dickieson
1964	Allen F. Donovan
1965	Hans Georg Clamann
	Billy E. Welch
1966	Charles A. Berry, M.D.
1967	Lee V. Gossick
1968	George C. Mohr

Eugene M. Zuckert Trophy

Established in 1966, the Zuckert Trophy is awarded to USAF personnel, civilian or military, male or female, "for outstanding professionalism." Groups of USAF personnel, as well as individuals, are eligible for this award.

1966	Gen. Bernard A. Schriever (USAF)	1968	Maj. Gen. Victor Haugen (USAF)
1967	Maj. Gen. Jewell C. Maxwell (USAF)		

L. British Interplanetary Society

Golovine Award

The first presentation off the Golovine Award was in 1967. It is given in recognition of the most outstanding contribution from an individual author in astronautics, space research, technology, or any associated subject such as space law, astronautics education, etc., published during the preceding two years.

1967	Gordon Sohl Robert C. Speiser	1968	Philip Bono

M. Fédération Aéronautique Internationale

Founded in 1905, the FAI authenticates official world air and space records and sponsors world and international sports aviation championships. The U.S. representative to FAI is the National Aeronautic Association.

Fédération Aéronautique Internationale Gold Air Medal

The FAI Gold Air Medal is awarded to persons who have contributed highly to the development of aeronautics.

1958	Andrey M. Tupolev	1964	Vladimir Kokkinake
1959	Pierre Satre	1965	Col. Robert L. Stephens (USAF)
1960	Yuri Gagarin	1966	Alexander S. Yakovlev
1961	Sir Geoffrey de Havilland	1967	Joe Walker
1962	No award given	1968	Maynard L. Pennell
1963	Jacqueline Auriol		

Fédération Aéronautique Internationale Gold Space Medal

Established in 1962, the FAI Gold Space medal is awarded to astronauts "who, alone or in groups, realize an outstanding performance in space."

1962	Andrian G. Nikolayev
	Pavel R. Popovich
1963	Valentina Nikolayeva-Tereshkova
1964	Vladimir Komarov
	Boris B. Yegorov
	Konstantin P. Feoktistov
1965	Aleksey Leonov
1966	Capt. James A. Lovell, Jr. (USN)
1967	No award given
1968	Col. Frank Borman (USAF)
	Capt. James A. Lovell, Jr. (USN)
	Lt. Col. William A. Anders (USAF)

N. Flight Safety Foundation

Laura Taber Barbour Award

The Laura Taber Barbour Award was established in 1956 and is given annually "for notable achievement which shall tend to advance safety in aeronautics and which contributes toward a method of avoiding . . . suffering or loss of life in air travel."

1958	James Martin
1959	Alan L. Morse
1960	Melvin N. Gough
1961	E. S. Calvert
	J. W. Sparke
1962	Otto E. Kirchner, Sr.
1963	David D. Thomas
1964	Philip Donely
	Jerome Lederer
1965	Arthur E. Jenks
1966	Francis P. McCourt
1967	W. M. Kauffman
	W. F. Milliken
	W. U. Breuhauf
1968	Walter Pye

Richard Hansford Burroughs International Test Pilot Award

Established in 1963, this award is given to "recognize contributions by a test pilot or group of test pilots to safe and efficient flight testing in the realm of atmospheric or space flight."

1963	Joseph J. Tymczyszyn
1964	Brian Trubshaw
1965	Fred J. Drinkwater III
1966	William M. Magruder
1967	John P. Reeder
1968	Alvin S. White

O. International Academy of Astronautics of the International Astronautical Federation

David and Florence Guggenheim International Astronautics Award

This award, established in 1961, is given annually "to an individual who has made outstanding contributions to the progress of astronautics during the preceding five years." The honorarium is $1000.

1961	Sir Bernard Lovell
1962	James A. Van Allen
1963	Marcel Nicolet
1964	Wallace Osgood Fenn
1965	Mstislav V. Keldysh
1966	Robert R. Gilruth
1967	Jacques-Emile Blamont
1968	Zdenek Svestka

P. International Astronautical Federation

Andrew G. Haley Award

Established in 1961, this award is given in recognition to the development of space law and international cooperation in the peaceful uses of space. It is named for Andrew G. Haley (1905-1966), an early advocate of outer space rule of law. The honorarium is $500.

1961	John Cobb Cooper Vladimir Kopal Michael Smirnoff
1962	Alex Meyer Manfred Lachs Antonio Ambrosini
1963	Eugene Pépin Ernst Fasan
1964	Eugene Korovine Cyril Horsford Aldo Armando Cocca
1965	Aldo Armando Cocca Myres McDougal
1966	Manfred Lachs
1967	No award given
1968	Eilene Galloway

Q. National Aeronautic Association

Formed in 1922, the NAA is the U.S. representative to the Fédération Aéronautique Internationale.

Frank G. Brewer Trophy

Established in 1943, the Frank G. Brewer Trophy is awarded annually for the greatest achievement in the field of air youth education and training, "accomplished by any individual, group of individuals, or organization."

1958	Evan Evans
1959	Paul E. Garber
1960	George N. Gardner
1961	James V. Bernardo
1962	Merlyn McLaughlin
1963	Marrilyn Link
1964	Gill Robb Wilson
1965	Jane N. Marshall
1966	Mervin K. Strickler, Jr.
1967	Roland H. Spaulding
1968	Joseph T. Geuting, Jr.

Robert J. Collier Trophy

This award was established in 1911 as the "Aero Club of America Trophy." In 1922, the Aero Club of America was incorporated into the National Aeronautic Association, and NAA renamed the award the Robert J. Collier Trophy in 1944 honoring its donor. The trophy is presented annually "for the greatest achievement in aeronautics or astronautics in America, with respect to improving the performance, efficiency or safety of air or space vehicles, the value of which has been thoroughly demonstrated by actual use during the preceding year." This award is usually presented by the President of the United States.

1958	U.S. Air Force and Industry Team responsible for the F-104 Interceptor Maj. Clarence L. Johnson (USAF) Neil Burgess Gerhard Neumann Maj. Howard C. Johnson (USAF) Capt. Walter W. Irwin (USAF)
1959	U.S. Air Force, Corvair, and Space Technology Laboratories
1960	Vice Adm. William Rayborn (USN)
1961	Maj. Robert M. White (USAF) Joseph A. Walker A. Scott Crossfield Cdr. Forrest S. Petersen (USN)
1962	Maj. L. Gordon Cooper, Jr. (USAF) Lt. Col. John H. Glenn, Jr. (USMC) Maj. Virgil I. Grissom (USAF) Lt. Cdr. Walter M. Schirra, Jr. (USN) Cdr. Alan B. Shepard, Jr. (USN) Maj. Donald K. Slayton (USAF) Lt. Cdr. M. Scott Carpenter (USN)
1963	Maj. Clarence L. Johnson (USAF)
1964	Gen. Curtis E. LeMay (USAF)
1965	James E. Webb Hugh L. Dryden
1966	James S. McDonnell, Jr.
1967	Lawrence A. Hyland
1968	Col. Frank Borman (USAF) Capt. James A. Lovell, Jr. (USN) Lt. Col. William A. Anders (USAF)

Wright Brothers Memorial Trophy

The Wright Brothers Memorial Trophy, established in 1948, is awarded each year to a living individual for "significant public service as a civilian of enduring value to aviation in the United States."

1958	John Francis Victory
1959	William P. MacCracken, Jr.
1960	Frederick C. Crawford
1961	A. S. "Mike" Monroney
1962	John Stack
1963	Donald W. Douglas, Sr.
1964	Harry F. Guggenheim
1965	Jerome Lederer
1966	Juan T. Trippe
1967	Igor I. Sikorsky
1968	Warren G. Magnuson

R. National Geographic Society

Hubbard Medal

This medal is conferred by the National Geographic Society's Board of Trustees for outstanding discovery and exploration. It is named in honor of one of the founders of the Society and its first president, Gardiner Greene Hubbard.

1958	Paul A. Siple
1959	Sir Vivian Fuchs U.S. Navy Antarctic Expeditions
1962	Dr. and Mrs. Louis S. B. Leakey John H. Glenn, Jr.
1963	American Mount Everest Expedition
1967	Juan Trippe
1968	Col. Frank Borman (USAF) Capt. James A. Lovell, Jr. (USN) Lt. Col. William A. Anders (USAF)

S. National Space Club

Founded as the National Rocket Club in 1957, the name was changed to the National Space Club in late 1963.

Astronautics Engineer Achievement Award

Established in 1959, the Astronautics Engineer Achievement Award is "given annually to an accredited engineer who has made an outstanding contribution to the advancement of space technology, an award based on personal accomplishment."

1959	Rudolf F. Hoelker
1960	Richard C. Canright
1961	William J. O'Sullivan, Jr.
1962	William G. Stroud
1963	Jack N. James
1964	Harold A. Rosen Donald D. Williams
1965	Harris M. Schurmeier
1966	Charles W. Mathews
1967	Robert J. Helberg
1968	Howard H. Haglund

Robert H. Goddard Historical Essay Award

Established in 1962, this award is made annually to the winner of a national competition in historic essays on rocketry and astronautics. The honorarium is $500.

1962	No award given
1963	R. Cargill Hall
1964	R. Cargill Hall
1965	John M. Tascher
1966	Airman 2/C Frank H. Winter (USAF)
1967	Ensign Richard A. Hobbs (USN)
1968	No award given

Robert H. Goddard Memorial Lecture

Established in 1966 by the National Space Club, this award stresses the importance of contributions made by Robert H. Goddard (1882-1945) to the development of the space program. Selection of the lecturer is made by a panel from men of high stature who have made outstanding contributions to the aerospace field. The honorarium is $1000.

1966	Robert C. Seamans, Jr.
1967	Joseph F. Shea
1968	Gen. Bernard A. Schriever (USAF, Ret.)

Robert H. Goddard Memorial Trophy

Established in 1958, this award is given annually for outstanding achievement to advance space flight programs contributing to U.S. leadership in astronautics.

1958	Wernher von Braun
1959	S. K. Hoffman
1960	Karel J. Bossart
1961	Lockheed Missiles & Space Co.
1962	Robert R. Gilruth
1963	Lt. Col. John H. Glenn, Jr. (USMC)
1964	Hugh L. Dryden
1965	William H. Pickering
1966	Lyndon B. Johnson
1967	George P. Miller
1968	Robert C. Seamans, Jr.

Nelson P. Jackson Aerospace Award

Established in 1960 in honor of a founder of the National Rocket Club, the Nelson P. Jackson Aerospace Award, now administered by the National Space Club, is awarded annually to a recipient in the aerospace industry "for an outstanding contribution of the missile, aircraft, and space field."

1961	U.S. Air Force and the Discoverer satellite industrial team: Bell Aerosystems Co., Douglas Aircraft Co., General Electric Co., Lockheed Aircraft Corp., and Rocketdyne Div. of North American Aviation, Inc.
1962	Astro-Electronics Div., Radio Corp. of America
1963	American Telephone & Telegraph Co.
1964	General Dynamics Astronautics Div. and McDonnell Aircraft Corp.
1965	Florida Research and Development Center, Pratt & Whitney Aircraft Div. of United Aircraft Corp.
1966	NASA-Air Force-Industry Team
1967	Boeing Co.
1968	Hughes Aircraft Co.

National Space Club Press Award

Established in 1960 as the National Rocket Club Award and later renamed the National Space Club Press Award, the honor is presented annually "in recognition of contributions which added to public understanding and appreciation of astronautics."

1961	Edward R. Murrow
1962	The *New York Times*
1963	Radio-Television Industry
1964	Editors and Staff of *Fortune* Magazine
1965	*Aviation Week & Space Technology* Magazine
1966	William P. Taub
1967	William J. Coughlin
1968	Edward C. Welsh

T. Society of Automotive Engineers, Inc.

Arch T. Colwell Merit Award

Established in 1965 by the Society of Automotive Engineers, Inc., the Arch T. Colwell Merit Award is given in recognition of outstanding technical papers in the field of automotive engineering. There is no restriction in this award as to the number of authors who may be honored.

1965 A. E. W. Austen
T. Priede
Kenneth C. Bachman
R. Thomas Bundorf
Walter Cornelius
L. William Huellmantel
Harry R. Mitchell
Paul H. Denke
Clayton W. Bentley
Robert T. Hunt
Walter B. Horne, LaRC
Upshur T. Joyner, LaRC
William LeFevre
K. J. McAulay
Tang Wu
Simon K. Chen
G. L. Borman
P. S. Myers
O. A. Uyehara
A. L. McPike
W. A. Turunen
J. S. Collman
1966 L. B. Graiff
Marvin W. Jackson
A. C. Knoell, JPL
S. O. Kronogard
Paul E. Kueser
Robert T. Larsen
W. M. Magruder
J. F. McDonald
W. J. Mayer
C. P. Moore
D. P. Krause
W. H. Lange
C. B. Murphy
J. J. Klepaczyk
Noel Penny
R. C. Puydak
R. S. Auda
Charles E. Scheffler
A. R. Spencer
W. M. Spurgeon
J. L. Wingle
1967 W. L. Brown
Fujio Nagao
Yuzuru Shimamoto
Bruce D. Van Deusen
Gerald E. McCarron
Ralph S. Mosher
H. K. Newhall
E. S. Starkman
W. A. Daniel
J. S. Alford
Philip Bono
Frank E. Senator
D'Amaso S. Garcia
Jay A. Bolt
David L. Harrington
M. L. Caplan
W. W. Thayer
J. D. Reams
R. G. Ahlvin
D. N. Brown
J. L. Bicknell
Walter Cornelius
Donald L. Stivender
Robert E. Sullivan
1968 I. N. Bishop
A. Simko
Jon D. Parisen
William A. McGowan
P. E. Rubbert
Gary R. Saaris
Donald E. Muehlberger
L. J. Nestor
L. Maggitti
Donald L. Stivender
Bo Björkman
Michael C. Kaye
Jerry P. Barrack
Jerry V. Kirk
John K. Jackson
Mario S. Bonura
David F. Putnam

James Craig Watson Medal

The James Craig Watson Medal was established in 1874 as a bequest of James Craig Watson, a former member of the Academy, to provide recognition of outstanding astronomical research.

1960	Yusuke Hagihara
1961	Otto Heckmann
1962	No award given
1963	No award given
1964	Willem J. Luyten
1965	Paul Herget
1966	Wallace J. Eckert (19th recipient)
1967	No award given
1968	No award given

D. Smithsonian Astrophysical Observatory

Thomas Hodgkins Prize

The Hodgkins gold medal, named for philanthropist Thomas G. Hodgkins (1803-1892), was first awarded in 1899 to James Dewar and for the second time in 1902 to J.J. Thomson. This award is made for contributions to atmospheric research and carries a $3000 honorarium for each recipient.

1965	Joseph Kaplan Marcel Nicolet Sydney Chapman (3rd, 4th, and 5th recipient)

E. Smithsonian Institution

Langley Medal

Established in 1908 by the Regents of the Smithsonian Institution, the Langley Medal was initiated by Alexander Graham Bell for the purpose of presenting an American award to the Wright Brothers. The Medal honors Samuel Pierpont Langley (1834-1906), aviation pioneer and founder of Smithsonian Astrophysical Observatory who served as the Smithsonian Institution's third Secretary from 1887 to 1906. Presented only occasionally, the medal is awarded by motion of the Secretary of the Smithsonian and a designated committee "for specially meritorious achievements in connection with the sciences of aeronautics and astronautics."

1960	Robert H. Goddard (posthumously)
1962	Hugh L. Dryden
1964	Cdr. Alan B. Shepard, Jr. (USN)
1967	Wernher von Braun (12th recipient)

F. United States Air Force

The Mackay Trophy (USAF)

The Mackay Trophy is awarded "to the Air Force person or persons who made the most meritorious flight of the year." The trophy was established in 1910 by Clarence H. Mackay and was first awarded in 1912 to Lt. Henry H. "Hap" Arnold. Deeded to the National Aeronautic Association after Mackay's death, the trophy is administered by the U.S. Air Force.

1958	TAC's Composite Air Strike Force
1959	USAF Thunderbird Aerial Team
1960	USAF 6593rd Test Squadron (Special)
1961	Maj. William R. Payne (USAF) Capt. William L. Polheumus (USAF) Capt. Raymond R. Wagner (USAF) (all of 43rd Bomb Wing)
1962	Maj. Robert G. Sowers (USAF) Capt. Robert McDonald (USAF) Capt. John T. Walton (USAF)
1963	Crew of C-47
1964	464th Troop Carrier Wing
1965	YF-12A/SR71 Task Force
1966	Lt. Col. Albert R. Horwarth (USAF)
1967	Maj. John H. Casteel (USAF) Capt. Richard L. Trail (USAF) Dean L. Hoar M/Sgt. Nathan C. Campbell (USAF)
1968	Lt. Col. Daryl D. Cole (USAF)

General Thomas D. White Space Trophy

Established in 1961 by Dr. Thomas W. McKnew, chairman of the National Geographic's Board of Trustees, the General Thomas D. White Space Trophy is presented annually to an Air Force member, Civil Service employee, or organization that made the foremost contribution to U.S. progress in aerospace. The trophy honors the late retired Air Force Chief of Staff.

1961	Capt. Virgil I. Grissom (USAF)
1962	Maj. Robert M. White (USAF)
1963	Maj. L. Gordon Cooper, Jr. (USAF)
1964	Air Force Systems Command
1965	Lt. Col. Edward H. White II (USAF)
1966	Alexander H. Flax
1967	John Paul McConnell
1968	Col. Frank Borman (USAF) Capt. James A. Lovell, Jr. (USN) Lt. Col. William A. Anders (USAF)

landing craft. NASA modified the *Retriever* in 1963 for use in operational and developmental testing of spacecraft postlanding systems and spacecraft recovery equipment and for development of postlanding procedures and techniques for flight crews and recovery personnel.

The 35-meter (115-foot) vessel, which carried a crew of 4 with space for 16 passengers, could operate at sea for up to a week. It was equipped with a 9000-kg (10-ton) ship's boom crane, a NASA recovery davit crane for recovery of Gemini and Apollo spacecraft, a portable data-acquisition van, and high-frequency, very-high-frequency, and ultrahigh-frequency communications. The Seabrook dock, with refueling capabilities and electrical utility connections, was an all-weather mooring dock with 47.2 meters (155 feet) of waterside-accessible length and an adjacent maneuvering area.[14]

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[14] NASA, *Technical Facilities Catalog* (March 1967 ed.), II, Sect. 11, 175-176.

WHITE SANDS TEST FACILITY
(WSTF)

Location: Las Cruces, Dona Ana County, New Mexico.

Land: 5196.5 hectares (55 934 acres) as of June 30, 1968 (under use agreement with the Department of the Army; arrangement to expire June 30, 1970, unless continued by agreement of both parties).

Manager: Martin L. Raines (October 1964-).
Paul E. Purser (Acting, July 1964-October 1964).
Wesley E. Messing (November 1962-July 1964).

History

White Sands Missile Range, activated July 13, 1945, was called White Sands Proving Ground (WSPG) until redesignated by the Army May 1, 1958.[1] The New Mexico site entered U.S. rocket history September 26, 1945, with the first development flight of the Army-Jet Propulsion Laboratory WAC-Corporal, the first U.S. liquid-propellant rocket developed with Government funds. On March 22, 1946, a JPL-Army Ordnance WAC launched from White Sands reached an 80.5-kilometer (50-mile) altitude, the first American rocket to escape the earth's atmosphere. In a record flight February 24, 1949, an Army-JPL Bumper WAC (WAC-Corporal with V-2 first stage) launched from White Sands reached 392.7-kilometer (244-mile) altitude and a speed of 8867.5 kilometers (5510 miles) per hour. Flight testing of captured V-2 rockets began at White Sands April 16, 1946. The group of German and Austrian engineers and technicians who had arrived at White Sands in December 1945 worked closely with General Electric Co. and Army Ordnance personnel in a series of 52 V-2 firings. This series, which included the Albert monkey flights, was completed June 28, 1950. The rocket development group was transferred to Redstone Arsenal in November 1950 and eventually formed the nucleus of NASA's Marshall Space Flight Center.[2]

In June 1962 Manned Spacecraft Center reached an operating agreement with the U.S. Army for establishment of an Apollo propulsion development facility at White Sands Missile Range.[3] NASA announced selection of the site in July 1962[4] and in November 1962 designated the facility MSC Resident Manager's Office at White Sands Missile Range.[5] On March 10, 1963, the office began using the designation MSC White Sands Missile Range Opera-

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[1] Department of the Army, General Order GO-14, April 29, 1958.

[2] Emme, *Aeronautics and Astronautics, 1915-1960*, 53. For additional references on the V-2 and ORDCIT (Army-JPL) programs at White Sands, see David S. Akens, *Historical Origins of the George C. Marshall Space Flight Center*, MSFC Historical Monograph No. 1 (Huntsville, Ala.: MSFC, December 1960), 28-35.

[3] MSC Weekly Activities Report, June 24-30, 1962; MSC Historian.

[4] MSC Message 7-02, July 2, 1962.

[5] MSC Announcement 102, Nov. 2, 1962.

The lunar module test stands (above) at the White Sands Test Facility, Las Cruces, New Mexico, photographed in April 1967. At right, the Apollo command module Boilerplate 23 and launch escape system waited atop the Little Joe launch vehicle for Dec. 8, 1964, test launch from Complex 36 of the historic White Sands Missile Range.

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tions, and on January 18, 1965, MSC announced that the facility would be called White Sands Operations.[6] On June 25, 1965, it was redesignated White Sands Test Facility.[7]

Mission

White Sands Test Facility was assigned responsibility for conducting or directing developmental and operational tests, primarily propulsion tests, and providing common-purpose laboratories, facilities, instrumentation, and other engineering and support services for these tests, in accord with directives originated by MSC program offices or technical divisions.[8]

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[6] MSC Announcement 65-6, Jan. 18, 1965.

[7] MSC Announcement 65-86, June 25, 1965.

[8] U.S. Congress, House, Committee on Science and Astronautics, Subcommittee on Manned Space Flight, *1967 NASA Authorization, Hearings*, Pt. 2, 89th Cong., 2d sess., Feb. 18, 24, March 1-31, 1966 (Washington, D.C.: GPO, 1966), 689.

Table 6–82. Technical Facilities: Crew Systems
(with costs in thousands)[a]

Functional Name	Facility Name	Year Built	Init. Cost	Accum. Cost	Research or Technological Area Supported
Materials physical test laboratory, nonmetallic	Nonmetallic Materials Physical Testing Laboratory	1962–1964	$ 100	$ 150	Development, evaluation, and testing of nonmetallic materials
Life sciences laboratory complex (Bldg. 7)	Laboratory Complex of Building 7	1963	1000	2350	Development of crew support equipment such as portable life support systems, survival equipment, space suits, instrumentation, mechanical systems, materials testing, chemical analysis, etc.
Materials environment laboratory, space suit	Materials Environment Testing Laboratory	1964	75	100	Thermal protection for space suit assembly materials
Impact test facility	Impact Test Facility	1965	314	435	Impact-testing of spacecraft components; test and evaluation of crew support systems, restraint systems, force attenuations and energy-absorption systems; qualification-testing of spacecraft systems for space flight
Life sciences laboratory complex (Bldg. 7A)	Laboratory Complex of Building 7A	1966	1350	2350	Development and support of crew systems functions as related to life sciences

[a] Excluding environmental test chambers. For definition of terms in headings, see introduction to Chapter Two.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), II, Sect. 11.

Table 6-83. Technical Facilities: Environmental Test Chambers
(with costs in thousands)

Functional Name	Facility Name	Year Built	Dimensions in Meters (and feet)	Pressure (Altitude), Meters (feet)	Temperature	Init. Cost	Accum. Cost	Research Supported
Environmental test facility (8-foot)	Eight Foot Diameter Altitude Chamber	NA	2.4 dia x 6.1 L (8 dia x 20 L)	68 580 (225 000)	–	NA[a]	$ 100	Development and qualification testing of environmental control systems, portable life support systems, space suits, and design verification of system components during manned and unmanned tests
Environmental test facility (Chamber E)	High to Ultra-High Vacuum Chamber "E"	1964	2.1 dia x 4.0 L (7 dia x 13 L)	10^{-9} torr	20 K (–423°F)	$ 250	250	Testing, R&D on spacecraft systems and components in high vacuum, with space environment simulations; thermal vacuum studies
Environmental test facility	Space Chamber Test Facility	1964	4.0-dia sphere (13-dia sphere)	10^{-5} torr	78 to 422 K (–320° to +300°F)	810.5	1 000	Spacecraft subsystems (primarily power generation and attitude control) design verification and development
Environmental test facility (20-foot)	Twenty-Foot Diameter Altitude Chamber	1964	6.1 dia x 6.7 H (20 dia x 22 H)	68 580 (225 000)	–	600	600	Development and qualification testing of boilerplate, spacecraft, environmental control systems, space suits, extravehicular activity (EVA) equipment, and system components during manned and unmanned tests; astronaut training for EVA, and rapid decompression testing
Environmental test laboratory, instrument[b]	Environmental Test and Evaluation Laboratory	1964	–	10^{-8} torr	89 to 533 K (–300° to +500°F)	350	940	Environmental qualification, testing and evaluation of instruments for use on manned spaceflight vehicles
Environmental test facility (Chamber B)	Space Environment Simulation Chamber "B"	1965	10.7 dia x 13.1 H (35 dia x 43 H)	2×10^{-6} torr	80 to 400 K (–316° to +260°F)	16 123	49 868[c]	Approximation of space environment conditions of temperature, pressure, and solar light for testing spacecraft and equipment

Table 6-83. Technical Facilities: Environmental Test Chambers (Continued)
(with costs in thousands)

Functional Name	Facility Name	Year Built	Dimensions in Meters (and feet)	Pressure (Altitude) Meters (feet)	Temperature	Init. Cost	Accum. Cost	Research Supported
Environmental test facility (Chamber A)	Space Environment Simulation Chamber "A"	1965	19.8 dia x 36.6 H (65 dia x 120 H)	6×10^{-7} torr	80 K (–316°F)	$33 246	NA[c]	Approximation of space environment conditions of temperature, pressure, and solar light for testing spacecraft and equipment
Environmental test facility (Chamber D)	Ultra-High Vacuum Space Simulation Chamber "D"	1966	2.7 dia x 5.5 H (9 dia x 18 H)	5×10^{-12} torr	14 K (–434°F)	750	$ 750	Testing, development, and research in spacecraft systems, components, complete craft, or materials, processes, etc., in ultrahigh vacuum, with space environment simulations

[a] USAF surplus.

[b] Contractor-operated (Lockheed Electronics Co.).

[c] Space Environment Simulation Laboratory cost, including Chambers A and B, laboratory complex, buildings, and two automated checkout equipment (ACE) stations.

NA = Data not available. For definition of terms in headings, see introduction to Chapter Two.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), II, Sect. 11.

Table 6-84. Technical Facilities: Flight Simulation and Training
(with costs in thousands)

Facility Name	Year Built	Init. Cost	Accum. Cost	Technological Areas Supported
Mission Simulation and Training Facility	1963	$ 2 500	$ 2 700	Operation, maintenance, and modification of space flight simulators for flight crew and ground crew training
Gemini Mission Simulator No. 2	1963	8 000	9 000	Flight crew and ground crew space flight training
Gemini Mission Simulator No. 1[a]	1963	8 000	9 000	Flight crew and ground crew space flight training
Gemini/Apollo Translation and Docking Simulator Complex	1964	1 200	1 800	Training of astronauts in manual control and development of docking procedures
Apollo Mission Simulator No. 1	1965	20 000	20 000	Simulation of space flight from earth launch to lunar landing and return
Dynamic Crew Procedures Simulator	1965	1 100	1 200	Simulation of space surroundings; development of procedures through kinesthetic cues and simulated motion
Flight Crew Training Building[b]	1965	1 559	2 834	Operation, maintenance, and modification of space flight simulators for flight crew and ground crew training
Lunar Mission Simulator (LMS) No. 1	1966	12 000	12 000	Simulation of mission operation and of landing and takeoff from lunar surface
Lunar Landing Training Vehicle (LLTV)	1966	900	900	Training of flight crews in flight techniques for final approach to lunar surface; simulation of handling qualities of lunar module (LM)
Apollo Mission Simulator (AMS) No. 2[b]	1966	20 000	20 000	Simulation of space flight from earth launch to lunar landing and return
Lunar Mission Simulator (LMS) No. 2	1966	12 000	12 000	Simulation of mission operation and of landing and takeoff from lunar surface

Table 6–84. Technical Facilities: Flight Simulation and Training (Continued)
(with costs in thousands)

Facility Name	Year Built	Init. Cost	Accum. Cost	Technological Areas Supported
Space Flight Mission Simulator Complex	1967	$12 000	NA	Development of operational procedures and training of astronauts in spacecraft manual-control procedures
Lunar Mission Simulator (LMS) No. 3[b]	1967	7 000	NA	Simulation of mission operation and of landing and takeoff from lunar surface
Apollo Mission Simulator No. 3	1967	14 000	NA	Simulation of space flight from earth launch to lunar landing and return

[a] Formerly at Kennedy Space Center; transferred to MSC June 1967.
[b] At KSC.

NA = Data not available. For definition of terms in headings, see introduction to Chapter Two.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), II, Sect. 11.

Table 6-85. Technical Facilities: Guidance and Control
(with costs in thousands)[a]

Functional Name	Facility Name	Year Built	Init. Cost	Accum. Cost	Technological Areas Supported
Stabilization and control systems laboratory	Systems Dynamics Laboratory	1964	NA	$ 1 700	Closed-loop system testing of spacecraft stabilization and control systems; control system component performance testing
Guidance and control electronics laboratory	Guidance and Control Electronics Laboratory	1964	NA	800	Research design and development of electronic systems for control of spacecraft attitude and translation motions
Guidance and control simulation laboratory	Simulation Laboratory	1964	$2 000	10 000	Simulation studies of spacecraft guidance and control systems
Guidance and navigation systems laboratory	Guidance and Navigation Systems Laboratory	1965	265	1 050	Optical and inertial guidance system testing
Inertial and optical laboratory	Inertial Optical Laboratories	1965	320	800	Test and evaluation of inertial components and subsystems; analytical and experimental studies of space visibility problems and determination of crew backup guidance capabilities

[a] All contractor operated (Lockheed Electronics Co.).

NA = Data not available. For definition of terms in headings, see introduction to Chapter Two.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), II, Sect. 11

Table 6-86. Instrumentation and Electronics Systems
(with costs in thousands)[a]

Functional Name	Facility Name	Year Built	Init. Cost	Accum. Cost	Technological Areas Supported
Magnetic tape recording laboratory	Magnetic Tape Recording Laboratory	1962	$ 60	$ 125	Magnetic tape system development, test and checkout, calibration, and evaluation
Signal conditioning laboratory	Signal Conditioning Laboratory	1962	38	183	Electronic equipment functional evaluation of spacecraft signal conditioning systems
Temperature evaluation laboratory[b]	High Temperature Evaluation Laboratory	1962	250	300	High-temperature thermal sensor evaluation, heat-transfer sensor design and evaluation, development and evaluation of heat-shield instrumentation, high-temperature coating technique evaluation.
Optical laboratory, physical	Physical Optics Laboratory	1964	30	80	Lens test and evaluation, optical detectors, telescopes, filters, infrared-ultraviolet-visible spectrum
Microcircuit techniques laboratory	Microcircuit Laboratory	1964	230	450	Microcircuitry for spacecraft electronic data and communication systems
Telemetry receiving techniques laboratory	Telemetry Receiving Techniques Laboratory	1964	200	850	Demultiplexing equipment development; data format conversion, demultiplexing, digitizing, recording, analysis
Instrumentation development laboratory	Development Flight Instrumentation (DFI) Breadboard Checkout Laboratory	1964	175	175	Design verification and acceptance of (Apollo) spacecraft development flight instrumentation. Government furnished equipment (GFE) systems
Transducer calibration laboratory[c]	Transducer Calibration Laboratory	1964	75	130	Calibration and evaluation of flight transducers used on spacecraft vehicles

Table 6–86. Instrumentation and Electronics Systems (Continued)
(with costs in thousands)[a]

Functional Name	Facility Name	Year Built	Init. Cost	Accum. Cost	Technological Areas Supported
Instrument calibration laboratory[c]	Standards and Calibration Laboratory	1964	$125	$ 775	Calibration of all electronics and physical sciences measuring instruments
Television systems laboratory	Television Systems Laboratory	1964	50	800	Spacecraft television, ground facilities processing equipment, image sensor development
Measurements laboratory	Measurements Laboratory	1964	50	50	Onboard (spacecraft) measurements of temperature, acoustics, pressure, vibration, acceleration, and inertia
Electrical power and sequencer laboratory	Electrical Power and Sequencer Laboratory	1964	8	44	Checkout, testing, evaluation, and qualification of spacecraft power distribution, batteries, inverters, sequencers, electrical power and control assemblies
Instrumentation calibration laboratory, analytical[d]	Analytical Instrumentation Calibration Laboratory	1964	85[e]	500	Analysis of gases, liquids, and solids used in connection with tests of flight equipment
Digital techniques laboratory	Digital Techniques Laboratory	1964	247	550	Spacecraft data-acquisition systems; flight-qualification-test process control and data analysis
Communications and instrumentation systems test facility	Spacecraft Systems Test Laboratory	1964	132	132	Testing of (Apollo) spacecraft communications and instrumentation systems
Telemetry systems laboratory	Telemetry Systems Laboratory	1964	282	310	Flight-qualification of spacecraft telemetry systems, GFE hardware, design and development of advanced analog data systems
Audio systems laboratory	Audio Systems Laboratory	1964	32	175	Speech bandwidth compression system development, audio devices development, and audio devices and system testing and evaluation
Anechoic chamber	Anechoic Chamber	1965	822	NA	Electromagnetic interference testing, antenna impedance or radiation pattern testing

Table 6-86. Instrumentation and Electronics Systems (Continued)
(with costs in thousands)[a]

Functional Name	Facility Name	Year Built	Init. Cost	Accum. Cost	Technological Areas Supported
Optical frequency laboratory and range	Optical Frequency Laboratory and Range	1965	$502	$ 669	Analysis of laser, infrared radars, high-data-rate laser deep-space communications systems, and infrared detectors and trackers
Antenna test range	Antenna Range	1965	548	NA	Measurements of antenna radiation patterns
Communications laboratory, R.F.	Radio Frequency Communications Laboratory	1965	500	1 000	Communications, tracking, and command systems
Timing systems laboratory, spacecraft	Spacecraft Timing Systems Laboratory	1966	269	NA	Development, evaluation, test, and checkout of spacecraft timing systems
Radar boresight range	Radar Boresight Range Facility	1966	248	423	Development of spacecraft rendezvous and landing radar systems

[a] Excluding environmental test chamber.
[b] At Ellington AFB.
[c] Contractor-operated (Lockheed Electronics Co.).
[d] Contractor-operated (Lockheed Electronics Co. and Philco Corp.).
[e] Equipment only.

NA = Data not available. For definition of terms, see introduction to Chapter Two.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), II, Sect. 11.

Table 6-87. Technical Facilities: Propulsion and Power, Landing and Recovery, and Information Systems (with costs in thousands)[a]

Functional Name	Facility Name	Year Built	Init. Cost	Accum. Cost	Technological Areas Supported
Power systems test facility, spacecraft	Power Systems Test Facility	1964	$ 560	$1 000	Thermal, transient, life, optimization, and failure mode investigations
Auxiliary propulsion test facility	Auxiliary Propulsion Test Facility	1964	1 695	2 000	Testing of small liquid-propulsion rocket engines under sea level and simulated altitude conditions
Pyrotechnics test facility	Pyrotechnics Test Facility	1964	542.9	700	Environmental and functional testing of spacecraft pyrotechnical devices and other spacecraft systems
Fluid systems test facility	Fluid Systems Test Facility	1965	1 427	1 600	Component and system cold flow, life cycling, proof and pressure, compatibility, leakage, dynamic response, and flight anomaly testing of spacecraft propulsion systems
Water test chamber facility	Water Test Chamber	1963	20	161	Operational and developmental testing of spacecraft postlanding systems and spacecraft recovery equipment; development of preliminary postlanding procedures and techniques for flight crews and recovery personnel; spacecraft postlanding motion analysis
Test article spacecraft assembly facility	Test Article Spacecraft Work Area	1965	30	30	Postlanding test-article spacecraft assembly and checkout
Electronic systems compatibility laboratory[b]	Electronic Systems Compatibility Laboratory	1966	3 200	3 200	Spacecraft-Manned Space Flight Network (MSFN) RF systems and related areas; compatibility and performance evaluation, special investigation, mission-profile simulation

[a] Excluding environmental test chambers. For definition of terms in headings, see introduction to Chapter Two.

[b] Contractor-operated (Lockheed Electronics Co.).

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), II, Sect. 11.

Table 6-88. Technical Facilities: Space Science
(with costs in thousands)

Functional Name	Facility Name	Year Built	Init. Cost	Accum. Cost	Technological Areas Supported
Lunar topographic and geologic simulation area	Lunar Topographic and Geologic Simulation Area	1964	$ 60	NA	Lunar surface technology
Accelerator facility, Van de Graaf	Van de Graaf Facility	1965	75	$ 80	Development of radiation detectors and instrumentation for radiation experiments
Solar radio frequency laboratory	Solar Radio Frequency Laboratory	1965	75	75	Solar flare observation
Radio telescope facility	Radio Telescope	1966	14	16	Gathering solar flare data
Cartographic laboratory	Cartographic Laboratory	1966	NA	NA	Lunar surface technology: cartography
Radiation instruments laboratory	Radiation Instruments Laboratory	1966	1 900	1 970	Environment measurement, dosimetry verification of space shielding and lunar surface experiments
Geophysics laboratory	Geophysics Laboratory	1966	NA	NA	Analysis of probable lunar surface conditions and materials
Geology and geochemistry laboratory	Geology and Geochemistry Laboratory	1966	NA	NA	Lunar geological exploration
Planetary atmospheres laboratory	Planetary Atmospheres Laboratory	1966	NA	NA	Study and analysis of interplanetary space weather and atmospheric densities
Lunar receiving laboratory	Lunar Receiving Laboratory	1967[a]	8 100	8 100	Receiving comprehensive scientific data and samples collected on lunar surface by astronauts on Apollo missions; providing isolation area for crews on return from moon

[a] Completed in December 1967; not included in *Technical Facilities Catalog.*

NA = Data not available. For definition of terms in headings, see introduction to Chapter Two.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), II, Sect. 11; MSC Historian.

Table 6–89. Technical Facilities: Structures and Mechanics
(with costs in thousands)[a]

Functional Name	Facility Name	Year Built	Init. Cost	Accum. Cost	Technological Areas Supported
Arc jet facility, subsonic 1.0 megawatt	1 Megawatt Arc Jet Facility	1963	$ 545	$ 545	Simulation of the heat-transfer rates and gas enthalpies of manned spacecraft reentry into the earth's atmosphere from earth orbital and lunar missions
Acoustic test laboratory, components	Components Acoustic Laboratory	1964	300	360	Dynamic structural testing, transmission loss of panels, component environmental testing, communications system testing
Drop test facility, one-sixth scale lunar module	One-sixth Scale Lunar Module Model Drop Facility	1964	6	6	Investigation of lunar module landing dynamics by dropping instrumented models on a landing surface
Acoustic test laboratory, spacecraft	Spacecraft Acoustic Laboratory	1965	3054	3054	Dynamic structural testing; dynamic systems testing
Vibration test laboratory	General Vibration Laboratory	1965	1808	NA	Dynamic structural testing; component environmental testing
Vibration test laboratory, spacecraft	Spacecraft Vibration Laboratory	1965	3104	3104	Dynamic structural testing; dynamic systems testing
Docking test facility, one-third scale Apollo	One-Third Scale Apollo Dock	1965	100	100	Model simulation of vehicle dynamic responses to probe and drogue impact
Structural test facility	600 000 Pound Capacity Universal Testing Machine	1966	185	200	General purpose machine for calibration and testing structures and structural components
Reentry materials and structures evaluation laboratory	Atmospheric Reentry Materials and Structures Evaluation Laboratory	1966	2900	NA	Simulation of hyperthermal conditions encountered by spacecraft structures and materials during entry into the earth's atmosphere and entry into planetary atmospheres
Arc tunnel, 1.5 megawatt	1.5 Megawatt Arc Tunnel Facility	1966	278	NA	Simulation of heating rates, pressures, and gas enthalpies of manned spacecraft reentry into the earth's atmosphere from orbital, lunar, and planetary missions

Table 6-89. Technical Facilities: Structures and Mechanics (Continued)
(with costs in thousands)[a]

Functional Name	Facility Name	Year Built	Init. Cost	Accum. Cost	Technological Areas Supported
Docking test facility, full-scale Apollo spacecraft (ADTD)	Apollo Docking Test Device (ADTD)	1966	$ 875	$2100	Dynamic simulation of all Apollo docking maneuvers by servo-actuation of the command-service module and lunar module docking interfaces
Impact test facility, water-land landing simulator	Water-Land Impact Test Facility	1966	NA	51	Spacecraft landing impacts in water and on land

[a] Excluding environmental test chambers.

NA = Data not available. For definition of terms in headings, see introduction to Chapter Two.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), II, Sect. 11.

Table 6-90. Technical Facilities: White Sands Test Facility
(with costs in thousands)

Functional Name	Facility Name	Year Built	Init. Cost	Accum.[a] Cost	Technological Areas Supported
Missile launch complex (Little Joe II)[b]	Little Joe II Launch Facility	1958	$1400	$2204.35	Launch facilities for testing pad abort, launch escape system, earth landing system, and structural system of (Apollo) spacecraft
Spacecraft checkout and test facility (CSM)[c]	Command and Service Module Preparation Building	1963	1390	NA	Prefire testing and functional checking of components of spacecraft modules and associated ground support equipment
Spacecraft assembly facility (LC-36)[b,d]	Vehicle Assembly Building	1963	366.5	NA	Assembly of spacecraft vehicles; prefire testing and functional checking of launch vehicles and associated ground support equipment
Rocket propulsion test stand (CSM 301)[b,c]	CSM Test Stand 301	1963	1492	NA	Static test-firing of multipropellant, gimbaled, rocket engines
Rocket propulsion control center (CSM)[c]	CSM Test Control Center	1963	3300	NA	Controlling operation and test-firing of atmospheric test stands
Radar flight test facility[d]	Apollo Rendezvous and Landing Radar Flight Test Facility	1964	42	335	Flight-testing of spacecraft rendezvous and landing radars
Laser field communications facility[d]	Laser Field Communications Facility	1964	40	200	Analysis of laser radars, high-data-rate laser communication systems, and infrared detectors and trackers
Rocket propulsion test stand (LEM)[f]	LEM Atmospheric Test Stand	1964	1312	NA	Static test-firing of multipropellant, gimbaled, rocket engines
Rocket propulsion test stand (CSM 302)[c]	CSM Test Stand 302	1964	1492	NA	Static test-firing of vertical, multipropellant, gimbaled, rocket engines
Rocket propulsion control center (LEM)[f]	LEM Control Center	1964	2950	NA	Controlling operation and test-firing of atmospheric test stand and altitude test chambers with associated altitude simulation system
Chemistry laboratory	Chemistry Laboratory	1964	179	NA	Analysis of liquids and gases, determination of chemical properties, performance of systems cleanliness tests, and performance of chemical compatibility studies

Table 6-90. Technical Facilities: White Sands Test Facility (Continued)
(with costs in thousands)

Function Name	Facility Name	Year Built	Init. Cost	Accum.[a] Cost	Technological Areas Supported
Spacecraft checkout and test facility (LEM)[f]	Lunar Excursion Module Preparation Building	1965	$1189	NA	Prefire testing and functional checking of spacecraft components and associated ground support equipment
Rocket propulsion altitude test chamber[f]	LEM Altitude Test Chamber	1965	4100	NA	Static test-firing of multipropellant gimbaled rocket engines at simulated altitude of up to 32 000 m (105 000 ft), or other tests up to simulated altitude of 76 200 m (250 000 ft)
Shock and vibration laboratory	Shock and Vibration Laboratory	1965	257[e]	NA	General vibration and shock investigation
Flowmeter calibration laboratory	Flowmeter Calibration Laboratory	1965	104[e]	NA	Measuring liquid flow; calibrating liquid flowmeters
Metallurgy-radiography laboratory	Metallurgy-Radiography Laboratory	1965	128[e]	NA	Determination of mechanical properties of materials, spectrographic analysis, radiographic inspection of metals, determination of carbon and sulfur present in metals, and of failure analysis
Environmental test facility	Chamber Laboratory	1965	216[e]	NA	Capabilities for temperature, humidity, and altitude-simulation (vacuum) environments

[a] Many accumulated cost figures were not available because single contracts represented construction and modification of more than one facility.

[b] On standby basis.

[c] Contractor-operated (North American Rockwell Corp.).

[d] On White Sands Missile Range.

[e] Equipment only.

[f] Contractor-operated (Grumman Aircraft Engineering Corp.).

NA = Data not available. For definition of terms in headings, see introduction to Chapter Two.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), II, Sect. 11, 177-210.

Table 6-91. Industrial Real Property
(as of June 30; money amounts in thousands)[a]

Category	McDonnell Douglas Corp. (Contract NAS 9-2539 F) St. Louis, Missouri		Massachusetts Inst. of Technology (Contract NAS 9-182 F) Cambridge, Massachusetts		North American Rockwell Corp. (Contracts NAS 7-90 F, NAS 7-300 F) NASA Industrial Plant-Downey, California[b]		Total	
	1967	1968	1967	1968	1967	1968	1967	1968
Land in hectares (and acres)	0	0	0	0		67.1 (165.9)	0	67.1 (165.9)
Buildings								
Number	1	1	0	0		82	1	83
Area, square meters	8.9	8.9				160 528.7	8.9	160 537.6
(and square feet)	(96)	(96)	0	0		(1 727 917)	(96)	(1 728 013)
Value								
Land	0	0	0	0		$ 3 570	0	$ 3 570
Buildings	$6	$6	0	0		23 935	$ 6	23 941
Other structures and facilities	0	0	$93	$94		4 998	93	5 092
Real property	$6	$6	$93	$94		$32 503	$99	$32 603

[a] These figures are included in Table 6-92; data for earlier years were not available.
[b] Responsibility for NASA Industrial Plant-Downey was transferred from Western Support Office to Manned Spacecraft Center March 1, 1968, when Western Support Office was disestablished.

Source: NASA, Office of Facilities.

Table 6-92. Property[a]
(as of June 30; money amounts in thousands)

Category	1962	1963	1964	1965	1966	1967	1968
Land in hectares (and acres)							
Owned	0	0	655.6 (1 620)	655.6 (1 620)	655.6 (1 620)	655.6 (1 620)	722.8 (1 785.9)[b]
Leased	8.1 (20)	8.1 (20)	194.3 (480)	0.8 (2)	0.8 (2)	0.7 (1.6)	— —
Buildings							
Number owned	0	2	15	60	83	161	251
Area owned, thousands of sq m (and sq ft)	0	0.6 (6)	39.5 (425)	154.6 (1 664)	200.4 (2 157)	244.5 (2 632)	415.0 (4 467)
Area leased, thousands of sq m (and sq ft)	29.0 (312)	33.8 (364)	4.9 (53)	2.4 (26)	2.4 (26)	2.4 (26)	0
Value							
Land[c]	0	0	$ 3 810	$ 4 157	$ 5 446	$ 5 418	$ 9 015
Buildings	0	$ 74	11 754	39 974	103 072	119 748	158 788
Other structures and facilities	NA	757	6 626	16 691	23 422	41 857	49 424
Real property	NA	$ 831	$22 190	$60 822	$131 940	$167 023	$217 227
Capitalized equipment	$3 800	$11 104	$19 312	$35 623	$ 96 599	$124 958	$154 973

[a] Including White Sands Test Facility, property at Ellington AFB and Seabrook Dock, and industrial property. For definition of terms, see introduction to Chapter Two.

[b] With the disestablishment of Western Support Office March 1, 1968, 67.2 hectares (165.9 acres) in Downey, California, were transferred to MSC. Most of the figure increases in the FY 1968 column may be attributed to this transfer (see Table 6-91).

[c] Including cost of erosion control and landscaping.

NA = Data not available.

Source: NASA, Office of Facilities. Supplementary information was provided by Leo T. Zbanek.

Table 6-93. Value of Real Property Components as Percentage of Total (as of June 30; total real property value in thousands)

Component	1963	1964	1965	1966	1967	1968
Land	0	17.1	6.8	4.1	3.3	4.2
Buildings	8.9	53.0	65.7	78.1	71.7	73.1
Other structures and facilities	91.1	29.9	27.5	17.8	25.0	22.7
	100.0	100.0	100.0	100.0	100.0	100.0
Total MSC real property value	$831	$22 190	$60 822	$131 940	$167 023	$217 227

Source: Derived from Tables 2-10 through 2-13 in Chapter Two.

Table 6-94. Personnel

Employee Category	1959		1960		1961[c]		1962		1963	
	6/30	12/31[a]	6/30[b]	12/31[a]	6/30	12/31	6/30	12/31[d]	6/30	12/31
Requested for FY ending									2700	
Total, paid employees		498		668	794	1146	1786	2392	3345	3364
Permanent		489		641	720	1035	1588	2239	3059	3297
Temporary		9		27	74	111	198	153	286	67
Code group (permanent only)										
200[e]		65		66	3	11	20	58	73	74
700[f]		201		260	351	458	755	1058	1398	1547
900		0		0	0	0	0	0	0	0
Subtotal		266		326	354	469	785	1116	1471	1621
600[g]		0		24	35	115	173	265	358	392
500		121		134	151	219	314	439	630	652
300		47		45	57	84	149	207	333	386
100		55		112	123	148	167	212	267	246
Subtotal		223		315	366	566	803	1123	1588	1676
Excepted: on duty		7		8	10	16	28	34	35	38
Accessions: permanent		NA		NA	93	304	597	746	948	475
Accessions: temporary		NA		NA	78	139	302	287	298	99
Military detailees		10		11	11	17	21	23	46	49

Table 6-94. Personnel (Continued)

Employee Category	1964		1965		1966		1967		1968
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Requested for FY ending	3980		4661		4686		4747		4634
Total, paid employees	4277	4721	4413	4391	4889	4688	5066	4728	4956
Permanent	4034	4605	4274	4325	4548	4649	4718	4606	4588
Temporary	243	116	139	66	341	39	348	122	368
Code group (permanent only)									
200[e]	73	72	67	69	68	54	50	54	52
700[f]	1929	2275	2108	2146	2301	2334	2440	2446	2436
900	0	10	9	11	14	16	15	15	16
Subtotal	2002	2357	2184	2226	2383	2404	2505	2515	2504
600[g]	446	531	521	551	563	560	631	660	650
500	800	875	850	835	890	943	905	790	789
300	476	516	480	484	504	537	465	451	497
100	310	326	239	229	208	205	212	190	148
Subtotal	2032	2248	2090	2099	2165	2245	2213	2091	2084
Excepted: on duty	36	35	29	29	29	30	28	33	34
Accessions: permanent	928	784	446	370	622	394	549	NA	NA
Accessions: temporary	273	176	137	237	328	73	313	NA	NA
Military detailees	60	69	69	148	202	214	203	192	188

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[a] Figures for Space Task Group were included in Goddard Space Flight Center reports; they are presented in this table for information only and are not added in NASA total.

[b] Data for Space Task Group are not available; figures were included in Goddard Space Flight Center reports.

[c] Space Task Group was established as an independent installation in January 1961, and personnel were transferred to STG from GSFC. In November 1961, Space Task Group was redesignated Manned Spacecraft Center.

[d] Data for [illegible] period ending Dec. 31, 1962, and subsequent periods include White Sands Test Facility.

[e] Beginning June 30, 1961, the data reflect conversion of some professionals from the 200 Code group (engineers) to the 700 Code group (aerospace technologists). For key to Code group numbers and definition of terms, see Chapter Three.

[f] Data before June 30, 1961, are for "aeronautical research scientists." Beginning June 30, 1961, the data reflect conversion of these personnel members to the 700 Code group (aerospace technologists).

[g] Before Dec. 31, 1960, the data reflect inclusion of Code group 600 personnel in the 500 Code group.

NA = Data not available.

Source: NASA, Personnel Division. Data through Dec. 31, 1966, from NASA Quarterly Personnel Statistical Report; data after Dec. 31, 1966, from NASA Personnel Management Information System and the NASA Supplement to SF 113-A, "Monthly Report of Federal Civilian Employment Short Form."

Table 6–95. Personnel: White Sands Test Facility

Employee Category	1962	1963		1964		1965		1966		1967		1968
	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Total, paid employees	10	60	91	143	167	158	151	138	128	119	109	90
Permanent	10	60	85	138	154	154	147	133	126	115	108	89
Temporary	0	0	6	5	13	4	4	5	2	4	1	1

Source: MSC, Manpower Management Branch.

Table 6–96. Distribution of Permanent Personnel Positions by Fiscal Year and Budget Activity[a]

Program	1961	1962	1963	1964	1965	1966	1967	1968
Manned space flight	805	1618	1960	2796	2982	3498	3345	3257
(% of total)	(100.0)	(99.9)	(65.5)	(67.0)	(70.4)	(73.8)	(71.1)	(70.8)
Space applications	0	0	0	0	0	0	26	48
(% of total)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.6)	(1.0)
Unmanned investigations in space	0	0	0	3	11	5	0	20
(% of total)	(0.0)	(0.0)	(0.0)	(0.1)	(0.3)	(0.1)	(0.0)	(0.4)
Space research and technology	0	0	44	47	2	7	21	20
(% of total)	(0.0)	(0.0)	(1.5)	(1.1)	*	(0.2)	(0.4)	(0.4)
Aircraft technology	0	0	0	0	0	0	0	0
(% of total)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Supporting activities[b]	0	2	990	1325	1242	1227	1312	1259
(% of total)	(0.0)	(0.1)	(33.0)	(31.8)	(29.3)	(25.9)	(27.9)	(27.4)
Total	805	1620	2994	4171	4237	4737	4704	4604

[a] Based on number of actual positions reported in annual NASA Budget Estimates. FY 1961 actual figure was reported in NASA, *Budget Estimates, FY 1963;* FY 1962 actual figure was reported in NASA, *Budget Estimates, FY 1964,* etc.

[b] FY 1963 and later figures include tracking and data acquisition, technology utilization, and general support positions. Until FY 1963, support positions were reported with the five other budget activities. FY 1962 figure is for technology utilization (reported as "industrial applications").

* = Less than 0.05%.

Source: NASA, *Budget Estimates,* FY 1963–FY 1969; NASA, Budget Operations Division.

Table 6-97. Funding by Fiscal Year
(program plan as of May 31, 1968; in millions)

Appropriation Title	1961	1962	1963	1964	1965	1966	1967	1968	Total
Research and development	0	$165.40	$689.10	$1363.70	$1431.40	$1515.70	$1445.80	$1177.30	$7788.40
Construction of facilities	0	73.10	24.52	34.08	19.79	4.18	10.20	0.75	166.62
Administrative operations[a]	$9.18	24.06	50.38	64.65	88.68	86.66	94.98	95.78	514.37
Total	$9.18	$262.56	$764.00	$1462.43	$1539.87	$1606.54	$1550.98	$1273.83	$8469.39

[a] FY 1961–1964 appropriations were for salaries and expenses; FY 1963 appropriation was for research, development, and operation.

Source: NASA, Office of Programming, Budget Operations Division, *History of Budget Plans, Actual Obligations, and Actual Expenditures for Fiscal Years 1959 through 1963* (Washington, D.C.: NASA, February 1965); NASA, Budget Operations Division, "Status of Approved Programs," FY 1959–FY 1968, May 1968.

Table 6-98. Actual Obligations for Construction of Facilities by Fiscal Year and Program Year
(in millions)

Program Year	Program Plan[a]	FY 1962	FY 1963	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	Total
1962	$ 73.9	$8.7	$32.0	$16.6	$10.4	$ 5.3	$ 0.5	*	$ 73.6
1963	25.9[b]		10.8	11.3	1.7	1.5	0.8	–*	25.9[b]
1964	34.8			11.9	19.4	2.3	0.8	$0.1	34.5
1965	21.1				8.8	7.4	0.6	0.2	17.0
1966	4.3					3.1	0.5	0.4	3.9
1967	10.4						8.0	1.3	9.3
1968	0.9							0.1	0.1
Total	$171.3	$8.7	$42.8	$39.8	$40.2	$19.5	$11.2	$2.1	$164.4

[a] As of June 30, 1968; includes facilities planning and design.

[b] Does not include $21.7 million programmed (FY 1963) and obligated for Mission Control Center which was reported with "Various Locations."

*=Less than $100 000. Because of rounding, columns and rows may not add to totals.

Source: NASA, Budget Operations Division, "Status of Approved Programs, Construction of Facilities," FY 1959–FY 1968, June 1968; NASA, Financial Management Division, "Summary Financial Status of Programs," June 30, 1968.

Table 6–99. Total Procurement Activity by Fiscal Year
(money amounts in millions)

	1961[a]	1962	1963	1964	1965	1966	1967	1968	Total
Net value of contract awards	$82.1	$204.8	$737.2	$1436.0	$1487.4	$1546.7	$1487.0	$1233.1	$8214.3
Percentage of NASA total	11%	13%	23%	31%	29%	31%	31.9%	29.9%	27.9%

[a] Space Task Group.

Source: NASA, Procurement and Supply Division, *NASA Procurement: October 1, 1959 to June 30, 1960* (Washington, D.C.: NASA, September 1960); NASA, *Annual Procurement Report*, Fiscal Years 1961–1968 (Washington, D.C.: NASA, 1962–1968).

Table 6-100. Awards to Personnel Granted under Section 306 of the Space Act of 1958[a]

Year	Inventor	Contribution	Amount
1962	Andre J. Meyer, Jr.	Vehicle parachute and equipment jettison system	$1000
	Maxime A. Faget Andre J. Meyer, Jr.	Emergency ejection device	1500
	Maxime A. Faget William M. Bland, Jr. Jack C. Heberlig	Survival couch	2100
	Maxime A. Faget Andre J. Meyer, Jr. R. G. Chilton W. S. Blanchard, Jr. A. B. Kehlet J. B. Hammack C. C. Johnson, Jr.	Space capsule	4200

[a] For complete listing of awards under this Act, see Appendix B, Sect. 1.B.

Source: NASA Inventions and Contributions Board.

GEORGE C. MARSHALL SPACE FLIGHT CENTER

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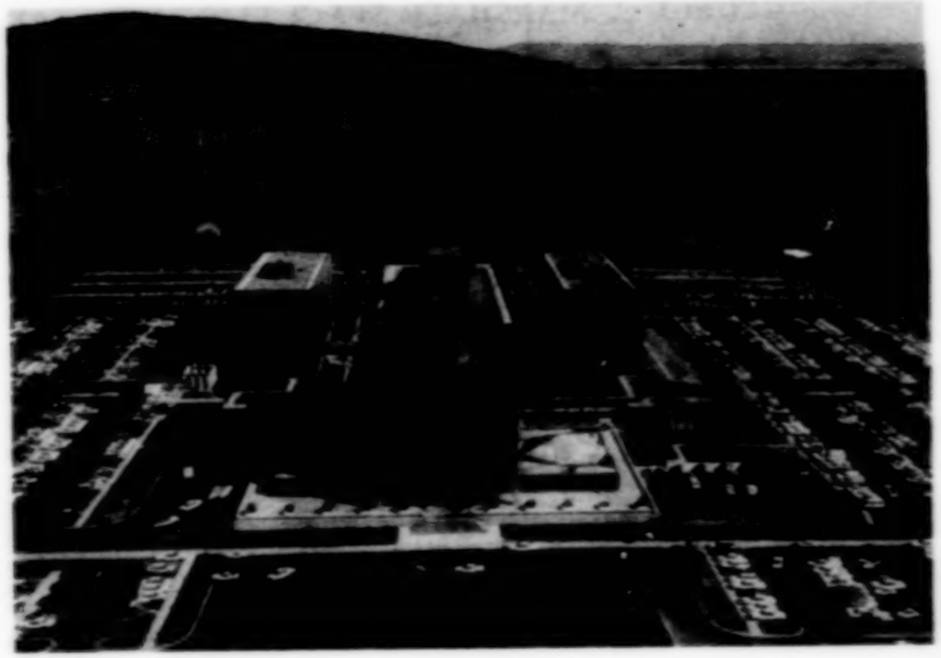

Three new office buildings housed some 2200 Government workers at Marshall Space Flight Center, Rideout Road, Huntsville, Alabama, in October 1965. The newest building was at the left; the middle building, containing the Director's office, was finished in 1963; and MSFC moved into the building on the right in mid-1964. The S-IC stage of the first Saturn V launch vehicle (right) was test-fired on MSFC's static test stand in October 1967 for the Nov. 9 *Apollo 4* launch.

GEORGE C. MARSHALL SPACE FLIGHT CENTER (MSFC)

Location: Huntsville, Madison County, Alabama.

Land: 1394.8 total hectares (3446.7 acres) as of June 30, 1968:
  - 727.2 hectares (1797 acres) under 99-year irrevocable use permit from U.S. Army.
  - 25.9 hectares (64 acres) leased on Green Mountain, Huntsville, Alabama.
  - 641.7 hectares (1585.7 acres) leased for contractor at Sacramento, California.

Director: Wernher von Braun (July 1, 1960-   ).

Deputy Director:
Eberhard F. M. Rees (July 1, 1960-   ).

Deputy Director Management:
Harry H. Gorman (Sept. 9, 1961-   ).
Delmar M. Morris (July 1, 1960-Sept. 9, 1961).

History

In 1941, the United States Army activated two facilities at Huntsville, Alabama–the Huntsville Arsenal, which manufactured and loaded chemical mortar and howitzer shells, and the Redstone Ordnance Plant, which assembled explosives for the chemical shells and produced complete rounds. Redstone Ordnance Plant, named for the color of the local rock and soil, was redesignated Redstone Arsenal February 26, 1943.[1]

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[1] David S. Akens, *Historical Origins of the George C. Marshall Space Flight Center*, MSFC Historical Monograph No. 1 (Huntsville, Ala.: MSFC, December 1960), 3, 36; Wernher von Braun, "The Redstone, Jupiter, and Juno," in Eugene M. Emme, ed., *The History of Rocket Technology: Essays on Research, Development and Utility* (Detroit: Wayne State University Press, 1964), 107-121; MSFC, Historical Office, "Historical Sketch of MSFC," mimeo (June 16, 1966), 6. The section on history of MSFC was prepared for the *Data Book* by David S. Akens and Rowene S. Dunlap of MSFC.

In a search for better facilities for an expanding U.S. Army rocket program, Army Ordnance officials from Fort Bliss, Texas, inspected the Huntsville Arsenal in September 1949. They proposed transfer to Huntsville of rocket scientists and technicians working on missile development for the Army at Fort Bliss, and the Secretary of the Army approved this recommendation October 28, 1949. In addition to military, civil service, and contractor personnel, the transfer included 130 Germans and Austrians led by Dr. Wernher von Braun, who had launched the first successful V-2 from Peenemünde October 3, 1942, and who had participated in the Army's missile development program at White Sands Proving Ground since January 1946. In April 1950, with the arrival of the von Braun team, Huntsville Arsenal became part of Redstone Arsenal, and the Army established the Ordnance Guided Missile Center there April 15, 1950.[2] During the 10 years between the move to Huntsville and the transfer to NASA, the Army group at Redstone developed the Redstone, Jupiter, and Juno missiles–each contributing to the U.S. space program.

Work on the Redstone missile began in 1950, and the Guided Missile Development Division's Missile Firing Laboratory (MFL) launched the first Redstone successfully August 20, 1953, from Cape Canaveral. During the five-year Redstone research and development test-flight program, the Army flew 37 Redstones to test missile structures, guidance and control equipment (basis for later guidance on space vehicles), tracking and telemetry, and other missile systems.[3]

From Redstone technology came the Jupiter intermediate range ballistic missile (IRBM), authorized by the Secretary of Defense November 8, 1955. Experiments conducted and discoveries made in the course of Jupiter IRBM development during the late 1950s proved useful in the Nation's space effort. The first Jupiter C (composite reentry test vehicle), a modified Redstone with two additional stages, was launched September 20, 1956, and the Jupiter C nosecone reentry tests the following year verified the ablation principle of heat protection later used in the manned space flight program. On May 31, 1957, the Jupiter, a single-stage, surface-to-surface, liquid-fueled missile, became the first successfully fired U.S. IRBM. Developed at the same time was a four-stage Jupiter C, the Juno I, which launched the first U.S. earth satellite, *Explorer I* on January 31, 1958. A significant Jupiter flight May 28, 1959, launched the primates Able and Baker into space and returned them in good health.[4]

The Army Ballistic Missile Agency (ABMA), officially established at Redstone in December 1955, became active February 1, 1956, and the Guided Missile Development Division (von Braun's group) became ABMA's

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[2] MSFC, Historical Office, "Historical Sketch," 5, 6; Memorandum, Asst. Chief of Ordnance (Army) to Commanding Officer, R&D Service Sub-Office, Fort Bliss, KCRC, Kansas City, Mo.; Akens, *Historical Origins*, 36; Jarrett and Lindemann, "Historical Origins of NASA's Launch Operations Center," 17.

[3] von Braun, "The Redstone, Jupiter, and Juno," 109-110.

[4] *Ibid.*, 116-117; Jarrett and Lindemann, "Historical Origins of NASA's Launch Operations Center," Append. B, 8-21.

Development Operations Division.[5] Shortly after its establishment October 1, 1958, NASA requested eight Redstones from ABMA for the Mercury program suborbital missions. After a series of test flights, the Mercury-Redstone 3 (MR-3) mission was launched May 5, 1961, with Astronaut Alan B. Shepard, Jr., as pilot in *Freedom* 7. MR-4, the last flight in the Mercury-Redstone program, was launched with Astronaut Virgil I. Grissom as pilot in *Liberty Bell 7* July 21, 1961.[6]

On August 15, 1958, the Department of Defense's Advanced Research Projects Agency (ARPA) approved ABMA's proposal for development of the Juno V, a large space vehicle booster with a 6672-kilonewton (1.5-million-pound) thrust.[7] An Advanced Research Projects Agency memorandum February 3, 1959, officially renamed the project Saturn.[8] President Eisenhower announced October 21, 1959, his decision to transfer the ABMA's Development Operations Division to NASA,[9] and transfer of the Saturn program to NASA became effective March 14, 1960. On that day NASA established the NASA Huntsville Facility and announced that personnel would be transferred from ABMA July 1.[10]

President Eisenhower signed Executive Order 10870 March 15, 1960, formally naming the Huntsville installation the George C. Marshall Space Flight Center in honor of George Catlett Marshall (1880-1959), the only professional soldier to win the Nobel Peace Prize. Officially, the George C. Marshall Space Flight Center (MSFC) began operations July 1, 1960, in the same facilities it occupied under the Army, and President Eisenhower dedicated the new Center September 8, 1960.[11]

Assembly of SA-1, the first Saturn I flight vehicle, was completed at Marshall January 16, 1961, and the vehicle was launched October 27. By July 30, 1965, when the Saturn I program ended, a total of 10 Saturn Is had flown successfully.[12]

On July 11, 1962, NASA announced the intermediate-size Saturn C-IB program; the vehicle was redesignated Saturn IB in early February 1963.[13]

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[5] Dept. of the Army, GO-68, Dec. 22, 1955; Jarrett and Lindemann, "Historical Origins of NASA's Launch Operations Center," 41.

[6] von Braun, "The Redstone, Jupiter, and Juno," 116. For a detailed account of the Mercury-Redstone program, see Swenson, Grimwood, and Alexander, *This New Ocean*, especially 293-301, 310-318, 328-330, and 341-377.

[7] MSFC Historical Office, *Saturn Illustrated Chronology*, MHR-4 (Huntsville, Ala.: MSFC, May 15, 1965), 1.

[8] *Ibid.*, 5.

[9] President Eisenhower, Statement, Oct. 21, 1959; Akens, *Historical Origins*, 69 ff.; Rosholt, *Administrative History of NASA*, 109, n. 145.

[10] Akens, *Historical Origins*, 76; Rosholt, *Administrative History of NASA*, 119-120; NASA Circular No. 57, March 14, 1960.

[11] President Eisenhower, Executive Order 10780, *Federal Register*, XXV (March 17, 1960), 2197; Rosholt, *Administrative History of NASA*, 120; Akens, *Historical Origins*, 81, 89-90.

[12] MSFC, *Saturn Illustrated Chronology*, 16, 45.

[13] *Ibid.*, 56, 69; NASA Release 62-159. From June 1966 until January 1968, the designation "Uprated Saturn I" was in use; see Memorandum, Julian Scheer, NASA Assistant Administrator for Public Affairs, June 9, 1966, and Memorandum, Scheer, Jan. 15, 1968.

The first Saturn IB (SA-201) was launched February 26, 1966.[14] The second flight (SA-203) was on July 5, 1966, and the third (SA-202), on August 25, 1966. SA-204, the fourth Saturn IB, launch vehicle was launched January 22, 1968, for the *Apollo 5* mission—the first unmanned orbital test of the Apollo lunar module.[15] SA-205 successfully launched *Apollo 7* October 11, 1968, on the first manned mission in the Apollo lunar landing program.[16]

NASA approved development of the Saturn C-5 vehicle January 25, 1962; in February 1963 the vehicle was redesignated Saturn V. Development and production of this launch vehicle for the Apollo program remained Marshall's chief mission. The first Saturn V was launched from John F. Kennedy Space Center, NASA, November 9, 1967. This initial test, the *Apollo 4* mission, was the first launch from Launch Complex 39.[17] The *Apollo 6* mission, the Saturn V's second flight, was launched April 4, 1968.[18] And on December 21, 1968, the Saturn V launched the most ambitious flight up to that date, the highly successful *Apollo 8* whose three-man crew orbited the moon 10 times. All subsequent Apollo flights were to be launched by the Saturn V.[19]

Mission

Marshall Space Flight Center was assigned responsibility for design, development, and test of launch vehicles and space transportation systems for manned space flight:

(1) Managing the Saturn IB program to provide a launch vehicle for Apollo spacecraft orbital development tests; the Saturn V program to provide the launch vehicle for manned lunar landing missions, planetary missions, and future very large scientific satellite payloads; and selected payloads for Apollo Applications missions;

(2) Designing, developing, and manufacturing large launch vehicle systems, including vehicle system test and integration; conducting test programs, such as dynamic and static testing programs; designing, developing, and testing large launch vehicle engines, such as the H-1, J-2, and F-1 systems; developing and integrating scientific experiment payload packages to be flown on Saturn-Apollo vehicles or subsequent post-Apollo missions.[20]

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[14] MSFC, Saturn Flight Evaluation Working Group, *Results of the First Saturn IB Launch Vehicle Test Flight AS-201*, Abstract (Huntsville, Ala.: MSFC, May 6, 1966).

[15] *Ibid.*, *Results of the Second Saturn IB Launch Vehicle Test Flight AS-203*, Abstract (Huntsville, Ala.: MSFC, Sept. 22, 1966); *Ibid.*, *Results of the Third Saturn IB Launch Vehicle Test Flight AS-202*, Abstract (Huntsville, Ala.: MSFC, Oct. 25, 1966); NASA Release 68-6.

[16] *Astronautics and Aeronautics, 1968* (Washington, D.C.: NASA SP-4010, 1969), 250-253.

[17] MSFC, *Saturn Illustrated Chronology*, 50, 69; MSFC Release 67-226; NASA Release 67-274, 275, 294.

[18] NASA Release 68-54; U.S. Congress, Senate, Committee on Aeronautical and Space Sciences, *Apollo 6 Mission, Hearing*, 90th Cong., 2d sess., April 22, 1968 (Washington, D.C.: GPO, 1968).

[19] *Astronautics and Aeronautics, 1968*, 318-322.

[20] NASA, *Budget Estimates*, FY 1969, IV, AO 2-19.

Defunct Names

Army Ballistic Missile Agency–activated February 1, 1956; discontinued July 22, 1960.

Army Ordnance Missile Command–established July 1, 1958; discontinued August 1, 1962; replaced by U.S. Army Missile Command under U.S. Army Materiel Command.

Development Operations Division (ABMA)–established February 1, 1956; became part of George C. Marshall Space Flight Center when it was established March 1960, effective July 1, 1960.

Experimental Missiles Firing Branch–established December 1, 1951; became Missile Firing Laboratory of Redstone Arsenal's Guided Missile Development Division, January 1953.

Guided Missile Development Branch–established August 1951; became Guided Missile Development Group, January 21, 1952.

Guided Missile Development Division–established January 1953; became Development Operations Division (ABMA), February 1, 1956.

Guided Missile Development Group–established January 21, 1952; became Guided Missile Development Laboratory, November 1952.

Guided Missile Development Laboratory–established November 1952; became Guided Missile Development Division, January 1953.

Huntsville Arsenal–activated August 4, 1941; merged with Redstone Arsenal, April 1950.

Juno V–redesignated Saturn February 3, 1959.

Launch Operations Directorate (MSFC)–established March 14, 1960, effective July 1, 1960; became NASA Launch Operations Center (LOC), March 7, 1962.

Launch Vehicle Operations Division (MSFC)–established March 7, 1962; gradually phased out.

Michoud Operations–established December 18, 1961; redesignated Michoud Assembly Facility, July 1, 1965.

Missile Firing Laboratory (Development Operations Division)–established January 1953; became MSFC's Launch Operations Directorate, July 1, 1960.

Mississippi Test Operations–established December 18, 1961; redesignated Mississippi Test Facility, July 1, 1965.

Ordnance Guided Missile Center–established April 15, 1950; became Guided Missile Development Branch of the Technical and Engineering Division, August 1951.

Ordnance Missile Laboratories–established September 18, 1952, with Technical and Engineering Division as part of it; disestablished February 1, 1956, with activation of ABMA.

Ordnance Rocket Center–established December 1950 with the separation of the Army Ordnance rocket program from the missile development program; became Rocket Development Branch of the Technical and Engineering Division, August 1951.

Pearl River Test Site–sometimes used for Mississippi Test Facility in November 1961; name discontinued by NASA, December 1, 1961.

Redstone Ordnance Plant–activated October 6, 1941; redesignated Redstone Arsenal, February 26, 1943.

Rocket Development Branch–established August 1951; became Rocket Development Group, January 21, 1952.

Rocket Development Group–established January 21, 1952; became Rocket Development Laboratory, November 1952.

Rocket Development Laboratory–established November 1952; became Rocket Development Division, January 1953.

Saturn C-1–redesignated Saturn I, February 1963.

Saturn C-IB–redesignated Saturn IB, February 1963.

Saturn C-5–redesignated Saturn V, February 1963.

Technical and Engineering Division (Redstone Arsenal)–established August 1951; became part of Ordnance Missile Laboratories, September 18, 1952.

Uprated Saturn I–designation for Saturn IB from June 1966 until January 1968.

MICHOUD ASSEMBLY FACILITY (MAF)

Location: New Orleans, Orleans Parish, Louisiana.

Land: 362.9 hectares (896.8 acres) total as of June 30, 1968:
- 360.5 hectares (890.8 acres) NASA-owned.
- 2.4 hectares (6.0 acres) under use permit from Dept. of Army XIX Corps.

Manager: George N. Constan (Jan. 14, 1962- ; Acting Manager, Sept. 20, 1961-Jan. 14, 1962).

History

The historical background of Michoud Assembly Facility spans two centuries of Louisiana history. The original land grant was made March 10, 1763, to Gilbert Antoine de St. Maxent, a New Orleans merchant. The property passed through several hands before it was sold to Antoine Michoud in 1827, and the Michoud family held the land until 1910.[1]

With the outbreak of World War II, the Government bought a 404.7-hectare (1000-acre) tract as a site for building ocean-going ships. After dredging the Michoud Canal, which connected the plant site with the Gulf Intracoastal Waterway, the project was changed, and in October 1942 a contract was issued to Higgins Industries of New Orleans for manufacturing large plywood cargo aircraft. The plant was dedicated October 4, 1943, but the Army Air Corps abandoned the project and closed the plant November 10, 1945. In 1951 the U.S. Army Ordnance Corps selected Michoud as the site for manufacturing engines for Sherman and Patton tanks, and awarded Chrysler Corporation a $30-million contract to reopen the facility. Officially opened on November 28, 1951, the plant was again deactivated in 1954.[2]

On September 7, 1961, NASA announced selection of the Government-owned Michoud Ordnance Plant as the site for industrial production of the S-I, S-IB, and later Saturn stages[3] and in October awarded a contract for rehabilitation and modification, to be completed before the end of the year.[4] The facility was officially designated NASA Michoud Operations December 18, 1961.[5]

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[1] The section on Michoud history was prepared for the *Data Book* by David S. Akens, MSFC, with additional information supplied by James M. Funkhouser and Lorraine Marthet, Michoud Assembly Facility.

[2] Michoud Operations Programs Office, "Michoud Operations: A Facility of the George C. Marshall Space Flight Center," updated Sept. 17, 1963, 2a-2c.

[3] NASA Release 61-201.

[4] Michoud Historical Report, Aug. 23, 1962.

[5] Letter, Dr. Robert C. Seamans, Jr., NASA Associate Administrator, to Harry H. Gorman MSFC, Deputy Director for Administration, Dec. 18, 1961, cited in MSFC, "History of the George C. Marshall Space Flight Center: July 1-December 31, 1961," MHM-4 (Huntsville, Ala.: MSFC, 1962), I, 38.

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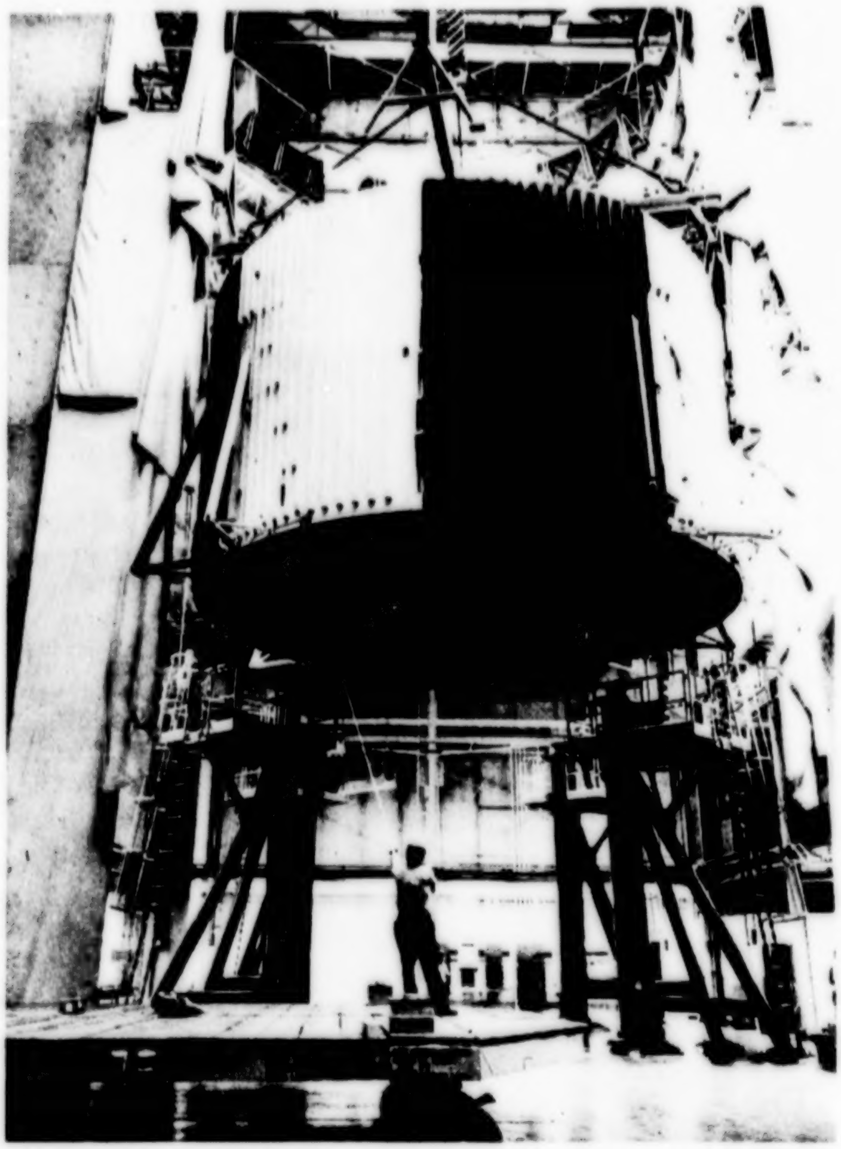

A 10-meter-diameter (33-foot-diameter) thrust structure for the Saturn V launch vehicle was lowered into vertical assembly position in March 1965 as assembly of the first S-IC stage began at Michoud Assembly Facility (then called Michoud Operations) in New Orleans. The assembled ground-test stage—42 meters (138 feet) tall with fuel tank, intertank structure, liquid oxygen tank, and forward skirt assembly added on top the thrust structure—would be shipped to MSFC later in the year.

Assembly of the first industry-produced booster was begun October 4, 1962, when Chrysler began fabrication of S-I-8.[6] On December 13, 1963, NASA accepted the first of two industry-built Saturn I first stages.[7] On October 22, 1962, Boeing activated the S-IC portion of the Michoud plant and began tooling and components manufacture.[8] Boeing completed assembly of its first complete Saturn V booster S-IC-D (dynamic test stage) in June 1965.[9] On July 1, 1965, MSFC announced that Michoud Operations had been redesignated Michoud Assembly Facility.[10]

Mission

Michoud Assembly Facility was assigned responsibility for assembly of Saturn IB and Saturn V launch vehicle first stages.[11]

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[6] MSFC, *Saturn Illustrated Chronology*, 64.

[7] MSFC, "History of the George C. Marshall Space Flight Center: July 1-December 31, 1963," MHM-8 (Huntsville, Ala.: MSFC, 1964), I, 30, 228.

[8] MSFC, "History of the George C. Marshall Space Flight Center: July 1-December 31, 1962," MHM-6 (Huntsville, Ala.: MSFC, 1963), I, 127, 217.

[9] MSFC, Saturn V Quarterly Progress Report, March-June 1965.

[10] Letter, David Newby, MSFC Office of the Director, to Dr. George E. Mueller, NASA Associate Administrator for Manned Space Flight, Sept. 18, 1964; MSFC Release 65-167.

[11] NASA, *Budget Estimates*, FY 1969, IV, AO 2-20.

COMPUTER OPERATIONS OFFICE

Location: Slidell, St. Tammany Parish, Louisiana.

Land: 5.7 hectares (14 acres) NASA-owned as of June 30, 1968.

Manager: Robert L. Reeves (Sept. 15, 1962-).

History

On March 23, 1962, Michoud Operations set up a Michoud Computer Steering Committee to direct the establishment of a Central Computer Facility. This committee selected as site a surplus building which had been constructed by the Federal Aviation Agency as an aircraft control center. On June 16, 1962, the MSFC Director ordered MSFC's Computation Division to begin interim operation of the facility until a contractor computer specialist could be selected. The first computer in the new facility became operational August 1, 1962.[1]

By November 12, 1962, the first phase of modifications to the building was complete, and all computers selected by the Steering Committee were operational by November 26. The second phase of construction, begun December 10, 1962, was completed in 1963.[2] At the end of FY 1968, Michoud was responsible for 22 general- and special-purpose computers.[3]

Mission

The Computer Operations Office was assigned responsibility for maintenance and management of a centralized data processing facility to meet the needs of MSFC and associated contractors in support of Michoud Assembly Facility and Mississippi Test Facility:

(1) Serving as official point of contact for contractors' data-processing activity in the MAF and MTF areas;

(2) Directing, developing, and implementing improved methods for furnishing the required data-processing services;

(3) Providing contract administration for a computer services contractor who would operate, schedule, and maintain data-processing equipment and provide specialized computer-programming technical capability as directed.[4]

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[1] MSFC, "History . . . July 1-December 31, 1962," II, 10-12.

[2] *Ibid.*, 13; NASA, *Technical Facilities Catalog* (March 1967 ed.), II, Sect. 12, 179-181.

[3] NASA, *Budget Estimates,* FY 1969, I, SA 15.

[4] NASA, *Technical Facilities Catalog,* II, Sect. 12, 180-181.

MISSISSIPPI TEST FACILITY (MTF)

Location: Hancock County, Mississippi.

Land: 56 198.7 hectares (138 870 acres) total as of June 30, 1968:
- 5434 hectares (13 428 acres) in test area, NASA-owned.
- 3058.6 hectares (7558 acres) in buffer zone, NASA-owned.
- 47 701.9 hectares (117 874 acres) in buffer zone, under restrictive easement.

Manager: Jackson M. Balch (May 9, 1965-).
William C. Fortune (Oct. 1, 1962-May 9, 1965).

History

In 1961 NASA decided to establish a national testing site for large launch vehicle stages.[1] Preliminary studies began in May, and on August 4, 1961, a Site Evaluation Committee was established. The Committee's criteria for the test site area included isolation from populated communities, accessibility by water and highway, availability of utilities, supporting communities within 80 kilometers (50 miles), and a climate permitting year-round operation.

A site on the Pearl River in southwestern Mississippi met all these requirements and was also close to NASA's Michoud Assembly Facility, where Saturn boosters were to be built.[2] On October 25, 1961, NASA announced its decision to establish the test facility in Hancock County as an activity of Marshall Space Flight Center.[3] NASA announced December 1, that the site was to be called Mississippi Test Facility, not "Pearl River Test Site," until an official title was chosen. Even after December 18, 1961, when NASA officially designated the facility Mississippi Test Operations (MTO), the name Mississippi Test Facility was frequently used, and in June 1963 Marshall Space Flight Center officially redesignated the facility Mississippi Test Operations.[4]

By October 1962 Mobile District Engineers Office had acquired all except 6 of the 163 tracts of land lying in the construction area, and the first tree

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[1] Rosholt, *Administrative History of NASA*, 215; MSFC, "History. . .July 1-December 31, 1962," II, Chap. VIII.

David S. Akens of MSFC prepared the MTF history section for the *Data Book*.

[2] MSFC, "History. . .July 1-December 31, 1962," II, Chap. VIII, 1-3; NASA, "Launch Vehicle Test Site Evaluation by Ad Hoc Site Selection Committee," Aug. 26, 1961, 8, 11-12.

[3] NASA Release 61-236.

[4] NASA Circular No. 188, Dec. 1, 1961; Letter, NASA Associate Administrator Dr. Robert C. Seamans, Jr., to Harry H. Gorman, MSFC Deputy Director for Administration, Dec. 18, 1961, cited in MSFC, "History. . .July 1-December 31, 1961," I, 38; Memorandum, Joseph H. Reed, Chief, MSFC Management Analysis Office, to Distribution, June 11, 1963, Subject: Change 50, MSFC Organization Manual.

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The S-IC-T test model of the Saturn V first stage was test-fired March 3, 1967, at the Mississippi Test Facility, Bay St. Louis, Mississippi. The static-firing proved the compatibility of stage, mechanical support equipment, and 124-meter (407-foot) test stand.

was felled May 17, 1963.[5] In July 1964, after court actions, acquisition of all land in the construction site was complete, and by December 31, 1964, the entire buffer zone had been acquired by the Government.[6] As of June 30, 1963, Marshall Space Flight Center had stationed 24 personnel members at the site, and by the end of 1964 this number had nearly doubled.[7] On July 1, 1965, Marshall announced that Mississippi Test Operations was officially redesignated Mississippi Test Facility (MTF).[8]

The first rocket stage to reach Mississippi Test Facility was the Saturn V second stage. S-II-T, an all-systems test model, arrived on October 17, 1965, after a 17-day trip from North American Aviation, Inc., Space and Information Systems Division at Seal Beach, California. Transported on the USNS *Point Barrow* through the Panama Canal to a Michoud Assembly Facility dock in New Orleans, the stage was transferred to the barge *Little Lake* for the last 72 kilometers (45 miles) up the Gulf Intracoastal Waterway and the East Pearl River to MTF. The S-II-T was unloaded to await installation in Test Stand A-2,[9] and on April 23, 1966, the stage was successfully static-fired for 15 seconds, marking the first operational use of Mississippi Test Facility.[10]

The first Saturn V first stage, S-IC-T, arrived on the barge *Poseidon* on October 23, 1966, from Michoud Assembly Facility, where it had been manufactured by Boeing. On December 17 workmen erected the stage in Stand B-2, activating the stand. The first systems demonstration test-firing, for 15 seconds, was successfully completed March 3, 1967.[11]

Mission

Mississippi Test Facility was assigned responsibility for acceptance test-firing of the 33 360-kilonewton-thrust (7.5-million-pound-thrust) Saturn V first stage (S-IC) and the 4448-kilonewton-thrust (1-million-pound-thrust) Saturn V second stage (S-II).[12]

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[5] MSFC, "Mississippi Test Facility Weekly Status Reports," Oct. 15, 1962, and Oct. 22, 1962; MTO Release, Aug. 24, 1964.

[6] MSFC, "History of the George C. Marshall Space Flight Center: July 1-December 31, 1964," MHM-10 (Huntsville, Ala.: MSFC, 1965), II, 87; *Business Week*, April 2, 1966, 5-7.

[7] MSFC, "History of the George C. Marshall Space Flight Center: January 1-June 30, 1963," MHM-7 (Huntsville, Ala.: MSFC, 1963), II, Chap. VIII, 3: "History. . .July 1-December 31, 1964," II, 108.

[8] Letter, David Newby, MSFC Office of the Director, to Dr. George E. Mueller, NASA Associate Administrator for Manned Space Flight, Sept. 18, 1964: MSFC Release 65-167; MSFC Circular No. 7-65, Subject: "Redesignation of MSFC Organizational Elements," July 6, 1965.

[9] *Marshall Star*, Oct. 20, 1965, 1,4; MSFC Release 65-246.

[10] MSFC, Saturn V Program Office, "Saturn V Quarterly Progress Report, April-June 1966," 19; MSFC Release 66-84.

[11] MSFC, Saturn V Program Office, "Saturn V Semi-Annual Progress Report, July-December 1966," and "Saturn V Semi-Annual Progress Report, January-June 1967"; *Marshall Star*, March 8, 1967, 1; Kurt Voss, "S-IC Test to Mark Progress in Mississippi," *Technology Week*, Feb. 6, 1967, 28-29; James C. Tanner, *Wall Street Journal*, Jan. 10, 1968, 8.

[12] NASA, *Budget Estimates*, FY 1969, IV, AO 2-20.

Table 6-101. Technical Facilities: Aero-Astrodynamics[a]

Functional Name	Year Built	Technological Area Supported
Wind Tunnel, Long Duration Aerodynamic	1943	Continuum flow investigations in a trisonic tunnel, a supersonic tunnel, and a jet flow facility
Shock Tunnel, Hypersonic	1943	Pressure investigation, heat transfer, and force testing with helium as the test medium
Gas Dynamics Laboratory, Rarefied	1943	Transitional and free-molecule-flow investigations; extreme-altitude jet pluming investigations
Vacuum Technology Laboratory	1943	High vacuum to 10^{-7} torr
Flow Research Facility, Astrodynamic	1953	Impulse-base-flow and heat-transfer studies

[a] Also called Gas Dynamics Research Facility (Aero-Astrodynamics); estimated initial cost, $4 143 000.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), II, Sect. 12, 1-16.

Table 6-102. Technical Facilities: Astrionics[a]

Functional Name	Year Built	Technological Area Supported
Inertial Sensor and Stabilizer Development Laboratory	1957	Missile technology, space technology, guidance, navigation
Guidance Technology Laboratory	1957	Applied missile technology, space technology, guidance
Instrumentation and Communication Development Laboratory	1957	Missile and space technology, guidance and control
Guidance and Control Systems and Components Laboratory	1957	Missile and space technology, guidance and control

[a] Estimated accumulated cost, $26 609 000.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), II, Sect. 12, 41-54.

Table 6-103. Technical Facilities: Manufacturing and Engineering[a]

Functional Name	Year Built	Technological Area Supported
Fabrication and Assembly Engineering Facility	1955	Launch vehicle and large component fabrication and assembly
Machine Shop Engineering Facility	1955	Precision machining and large component machining
Tube Cleaning Facility	1955	Tube cleaning up to 76-mm (3-in.) diameter and 18.3 m (60 ft) long
Valve Clinic Facility, Propellant	1955	Propellant-valve disassembly, cleaning, and assembly
Surface Treatment Facility	1960	Chemical and mechanical cleaning, electropolishing, painting, anodizing, chemical milling, pickling, passivating, and metal plating
Metal Forming and Fabrication Facility	1955	Metal forming and joining of large vehicle sections
Composite Structure Fabrication Facility	1956	Fabrication of large composite-structure panels in steel, steel alloys, or aluminum
Welding Development Facility	1956	Precision and specialty welding
Manufacturing Methods Development Facility	1955	Development of mechanical manufacturing processes and methods
Manufacturing Techniques Development Facility Electronics	1943	Adaptation of advanced scientific discoveries to manufacturing techniques

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), II, Sect. 12, 75-98.

[a] Estimated accumulated cost, $23 238 000.

Table 6-104. Technical Facilities: Propulsion and Vehicle Engineering[a]

Functional Name	Year Built	Technological Area Supported
Structural Static Test Facility	1959	Stage and component structural checkout
Vibration Test Facility	1959	Vibration testing of stages and components with various vibration exciters
Shock and Acceleration Test Facility	1959	Shock testing in stage and component structural checkout
Acoustic Test Facility	1959	Acoustic testing in reverberation room and anechoic room
Heat Transfer Test Facility	1959	Heat transfer in propellant systems, two-phase flow systems (liquid vapor), insulation schemes for cryogenic tanks, and calorimeter development for heat radiation measurements
Hydraulics Research Facility	1959	Hydraulics testing of stages and components with 4 hydraulic fluid and RPI flow stands, 1 impulse test stand, 1 pump test stand, and engine gimbal test stands
Pneumatic & Cryogenic Test Facility	1959	Studies of vortex, terminal drainage, surge pressure, stratification, bubble dynamics, and geysering in turbulent fluid flow
Materials Laboratory	1959	Evaluation and development of materials and components; determination of effects of vacuum, temperature, radiation, hypervelocity impact, and other environmental conditions.

[a] Estimated accumulated cost, $25 125 000.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), II, Sect. 12, 55-74.

Table 6–105. Technical Facilities: Quality and Reliability Assurance[a]

Functional Name	Year Built	Technological Area Supported
Dimensional Laboratory	1961	Length, threads, optics, angles, roundness, hardness, and flatness tests
Physical Laboratory, Quality Assurance	1961	Pressure, mass, torque, and force acceleration tests
Electrical/Electronics Laboratory, Quality Assurance	1961	Voltage, resistance, current, and frequency tests
Environmental Test Laboratory, Quality Assurance	1955	Force application and environmental qualification testing of flight components

[a] Estimated accumulated cost, $16 051 000.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), II, Sect. 12, 99–110.

Table 6-106. Technical Facilities: Research Projects[a]

Functional Name	Year Built	Technological Area Supported
Radiative and Conductive Physics Laboratory	1962	Thermal conductivity of solid particles
Meteoroid Physics Laboratory	1962	Production of high-velocity, high-density plasmas, and calibration of meteoroid detectors
Geology and Geophysics Laboratory	1961	Secondary impact effects in vacuum upon nonmetallic "rock" materials
Magnetic Field Measurement Physics Laboratory	1962	Electric and magnetic field meter evaluation
Radiation Physics Laboratory	1962	Space vehicle radiation shielding
Optical Physics Laboratory	1962	Rocket combustion products research in simulated planetary atmosphere
Thermal Environment Physics Laboratory	1962	Space environmental effects on radiometric characteristics
Reaction Kinetics Laboratory	1962	Launch vehicle gases and vapors analysis
Plasma Physics Laboratory	1966	Space plasma studies
Surface Physics Laboratory, Space Vehicle	1962	Space environment interactions with space vehicle surfaces
Computer Techniques Laboratory	1964	Development of advanced methods of data anlaysis and translation

[a] Estimated accumulated cost, $2 683 000.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), II, Sect. 12, 15–40.

Table 6–107. Technical Facilities: Rocket Propulsion Test Complex[a]

Functional Name	Facility Name	Year Built	Technological Area Supported
Rocket propulsion test stands:			
(S–IC 4670)	S–IC Static Test Stand (4670)	1965	Saturn V 1st stage (S–IC) checkout and acceptance firing, propulsion system development
(F–1 4696)	F–1 Engine Test Stand (4696)	1963	Engine propulsion and functional testing
(S–IVB 4514)	S–IVB Test Stand (4514)	1965	Saturn V 3rd stage integration testing, R&D propulsion systems testing
(4572)	Static Test Stand (4572)	1957	Stage and engine functional and acceptance testing
(H–1 4564)	H–1 Power Plant Test Stand	1957	Stage integration, R&D propulsion system testing
(Redstone 4665)	Interim (Redstone) Test Stand (4665 Area)	1953	Rocket propulsion
Rocket exhaust effects test stand (4665 area)	Sound Suppressor Test Stand (4665 Area)	1953	Sound suppression
Rocket propulsion altitude test stand (4710)	Liquid Hydrogen Familiarization Facility (4710)	1957	Hydrogen-fueled engines
Rocket propulsion altitude test cell (4753)	Storable Propellant Test Facility (4753)	1951	Storable-propellant engines, altitude firing
Propellant systems test stand, cold flow (4588)	Cold Calibration Test Stand (4588)	1957	Propellant systems
Propellant systems test stand, cold flow (4548)	F–1 Turbopump Facility (4548)	1964	Propellant feed systems
Vibration effects test stand, rocket (4557)	S–IB Dynamic Test Stand (4557)	1962	Saturn IB structural dynamics and propellant tankage
Vibration effects test stand, rocket (4550)	S–V Dynamic Test Stand (4550)	1964	Saturn V structural dynamics

Table 6-107. Technical Facilities: Rocket Propulsion Test Complex[a] (Continued)

Functional Name	Facility Name	Year Built	Technological Area Supported
Drop tower, reduced gravity effects (4550)	Low Gravity Test Facility (4550)	1964	Low-gravity physical phenomena
Environmental test facility (4748)	Ultra High Vacuum Facility (at 4748)	1951	Space environment effects, propellant systems
Environmental test facility, rocket systems (4750)	Test Facility Building (4750)	1955	Rocket system altitude ignition and launch methods
Rocket component hazardous test cells (4583)	Test Positions 100 through 108 (4583)	1957	Propellant flow and combustion, nozzles and component hardware
Altitude test cell (4583)	Test Position 112 (4583)	1957	Altitude studies, such as materials tests, ignition problem studies, scaled vehicle studies
Rocket propulsion test stand, model and component (4583)	Test Positions 113, 114, and 117 (at 4583)	1957	Rocket combustion and component hardware
Rocket propulsion test stand (4583)	Test Position 115 (at 4583)	1957	Rocket combustion, He and LH_2
Rocket acoustic effects test stand (4540)	Test Position 116 (at 4540)	1964	Dynamic pressure effects, low-frequency noise
Rocket component test stand (4530)	Test Positions 301 and 302 (4530)	1964	Rocket hardware
Rocket component test stand, LOX/H cold flow (4522)	Test Position 500 (dual 501 and 502) (4522)	1964	Propellant systems
Launch simulation facility, Saturn V (4646)	Saturn V GSE Test Facility (at 4646)	1964	Launch pad equipment
Missile liftoff simulator facility (4583)	Swing Arm Test Facility (at 4583)	1957	Launch

Table 6-107. Technical Facilities: Rocket Propulsion Test Complex[a] (Continued)

Functional Name	Facility Name	Year Built	Technological Area Supported
Fluid flow and pressure test facility (4648)	High Pressure Fluid Test Facility	1965	Rocket fluid systems, ground support equipment
Instrument laboratory (4650)	Instrument Laboratory	1958	Ground support and test instrumentation
Acoustic investigation facility (4565)	Noise Source for the Far Field Noise Propagation and Measurement System (4565)	1952	Rocket noise measurements

[a] Estimated accumulated cost, $107 408 000.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), II, Sect. 12, 111–172.

Table 6-108. Technical Facilities: Michoud Assembly Facility (with costs in thousands)[a]

Functional Name	Facility Name	Year Built	Init. Cost	Accum. Cost	Technological Areas Supported
Flow test facility, high-pressure gas	High Pressure Test	1964	$ 140.5	$ 377.5	Dynamic and steady-state gas flow testing under extreme pressure, temperature, and flow conditions
Stage test position facility	Stage Test Position Facility	1965	$1809.7	$1889.5	System checkout of Saturn V 1st stage before and after static test-firing

[a] For definition of terms in headings, see introduction to Chapter Two.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), II, Sect. 12, 175–178.

Table 6–109. Technical Facilities: Mississippi Test Facility
(with costs in thousands)

Functional Name	Facility Name	Year Built	Init. Cost	Accum. Cost	Technological Areas Supported
Acoustic laboratory, all purpose[a]	Acoustics Laboratory	1965	NA	NA	Far-field, mid-field, near-field, and special-purpose acoustics data collection; calibration, maintenance, and repair of acoustic devices
Measurement standards laboratory[a]	Measurement Standards Laboratory	1965	NA	NA	Primary standards in support of Electronics, Instrumentation and Materials Laboratory functions and secondary standards for site-wide support
Pressure and strain calibration laboratory[a]	Pressure and Strain Calibration Laboratory	1965	NA	NA	Site-wide pressure and strain calibration support
Atmospheric laboratory	Meteorology Building	1965	NA	NA	Atmospheric observations and predictions in support of acoustic propagation predictions; severe weather warning service
Electronics, instrumentation and materials laboratory[a]	Electronics, Instrumentation and Materials Laboratory	1965	$2027	$2047	Materials analysis, measurement standards, photographic, pressure and strain, temperature and flow, and field support
Rocket propulsion test complex, Saturn IC (B–1, B–2)	S–IC Test Stand	1965	1993	2091	Static firing of Saturn V 1st stage
S–II A–2 test stand[b] (A–1, A–2)	S–II A–2 Test Stand (A–1, A–2)	1965	1195	1571	Static firing of Saturn V 2nd stage
Data handling facility[a]	Data Handling Center	1965	653	2879	On-site data reduction (digital and analog) for the Data Acquisition Facility and other test elements at MTF
Rocket components service facility[c]	Component Service Facility	1966	NA	NA	On-site repair, servicing, and test operations on Saturn V 2nd stage J–2 engines

Table 6-109. Technical Facilities: Mississippi Test Facility (Continued)
(with costs in thousands)

Functional Name	Facility Name	Year Built	Init. Cost	Accum. Cost	Technological Areas Supported
Cryogenic component test facility[a]	Component Service Facility (CSF)	1966	NA	NA	Cryogenic testing of components
Data acquisition facility (DAF)	Data Acquisition Facility	1966	$9320	$9490	Acquistion and recording of data signals transmitted via land lines from test vehicles, flight vehicles, and static-test support facilities within Saturn V complex

[a] Contractor-operated (General Electric Co.).

[b] Contractor-operated (Space and Information Systems Div., North American Rockwell Corp.).

[c] Contractor-operated (Rocketdyne).

NA = Data not available. For definition of terms in headings, see introduction to Chapter Two.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), II, Sect. 12, 183-219.

Table 6-110. Industrial Real Property
(as of June 30; money amounts in thousands)[a]

Category	McDonnell Douglas Corp.		North American Rockwell Corp.												Total	
	Contract NAS 7-180 Sacramento, Calif.		Contract NAS 8-5609 Edwards, Calif.		Contracts NAS 8-14006, NAS 7-90 Seal Beach, Calif.		Contracts NAS 8-14006, NAS 7-90 Santa Susana, Calif.		Contract NAS 8-5609 Canoga Park, Calif.		Contract NAS 8-5609 Santa Susana, Calif.		Contract NAS 8-5609 Neosho, Calif.			
	1967	1968	1967	1968	1967	1968	1967	1968	1967	1968	1967	1968	1967	1968	1967	1968
Land	0	0	0	0	0	0	0		0	0	0	0	0		0	0
Buildings																
Number	14	15	11	12	6	6	1		0	0	0	1	0		32	34
Area, thousands of sq m (and sq ft)	9 262.9 (99 705)	10 049.1 (108 168)	10 289.4 (110 755)	10 334.0 (111 235)	23 123.3 (248 897)	23 606.4 (254 097)	413.9 (4455)		0	0	0	413.9 (4455)	0		43 089.5 (463 812)	44 403.5 (477 955)
Value																
Land[b]	0	0	$ 2 467	$ 2 720	$ 364	$ 384	$1148		0	0	0	$ 603			$ 3 979	$ 3 707
Buildings	$ 6 607	$ 6 576	3 347	2 866	10 969	10 933	56		0	0	0	117	0		20 979	20 492
Other structures and facilities	11 374	20 469	13 510	14 044	1 815	2 172	3271		$2754	$2415	$464	3678	$87		33 275	42 778
Total industrial real property value	$17 981	$27 045	$19 324	$19 630	$13 148	$13 489	$4475		$2754	$2415	$464	$4398	$87		$58 233	$66 977

[a] These figures are included in Table 6-111.

[b] NASA-funded capital improvements to contractor-owned land.

[c] Combined figures for FY 1968.

Source: NASA, Office of Facilities.

Table 6–111. Property
(as of June 30; money amounts in thousands)[a]

Category	1961	1962	1963	1964	1965	1966	1967	1968
Land in hectares (and acres)								
Owned	654.4	654.4	722.8	722.8	727.2	727.2	727.2	727.2
	(1617)[b]	(1617)[b]	(1786)	(1786)	(1797)	(1797)	(1797)	(1797)
Leased	25.9	25.9	25.9	25.9	25.9	25.9	25.9	667.6
	(64)	(64)	(64)	(64)	(64)	(64)	(64)	(1649.7)
Buildings								
Number owned	161	158	142	122[c]	192	161	176	182
Area owned, thousands of sq m	145.2	159.6	208.1	231.3	319.8	335.7	369.6	386.7
(and sq ft)	(1563)	(1718)	(2240)	(2490)	(3442)	(3655)	(3978)	(4163)
Area leased, thousands of sq m	0	22.2	24.7	24.7	14.8	2.4	2.2	2.2
(and sq ft)[d]		(239)	(266)	(266)	(159)	(26)	(24)	(24)
Value								
Land[e]	$ 86	$ 86	$ 95	$ 95	$ 406	$ 2 106	$ 4 074	$ 3 802
Buildings	36 160	39 233	50 136	55 517	77 546	95 431	110 744	123 089
Other structures and facilities	572	718	6 015	9 628	56 769	54 121	68 755	81 970
Real property	$36 818	$40 037	$56 246	$65 240	$134 721	$151 658	$183 573	$208 861
Capitalized equipment	$45 000	$51 000	$64 676	$84 149	$103 240	$244 962	$256 297	$302 575

[a] Does not include Michoud Assembly Facility, Computer Operations Office, or Mississippi Test Facility, except in Line 10 ("Capitalized equipment value"); includes industrial property. For breakdown of 1967 and 1968 figures on industrial facilities, see Table 6–110. For definition of terms, see introduction to Chapter Two.

[b] Acreage acquired from Department of the Army July 1, 1960 (under 99-year irrevocable agreement, considered by GSA as equal to ownership). Not included in NASA total for FY 1962 in Table 2–5, Chapter Two.

[c] Although number of buildings decreased between FY 1961 and FY 1964, square footage and value of buildings increased because of replacement of older buildings and consolidation.

[d] Does not include GSA-leased buildings.

[e] Figures for 1965–67 include NASA-funded capital improvements to contractor-owned land.

Source: NASA, Office of Facilities. Supplementary information was provided by S. R. Stewart.

Table 6-112. Property: Michoud Assembly Facility
(as of June 30; money amounts in thousands of dollars)[a]

Category	1962	1963	1964	1965	1966	1967	1968
Land in hectares (and acres)							
Owned	333.9 (825)[b]	333.9 (825)	333.9 (825)	360.5 (890.8)[c]	360.5 (890.8)	360.5 (890.8)	360.5 (890.8)
Leased	0	0	0	0	0	0	0
Buildings							
Number owned	0	21	19	23	31	32	33
Area owned, thousands of sq m (and sq ft)	226.5 (2438)	235.4 (2534)	237.2 (2553)[d]	238.7 (2569)	323.7 (3484)	330.6 (3559)	330.6 (3559)
Area leased, thousands of sq m (and sq ft)	0	35.4 (381)	28.0 (301)	0	0	0	0
Value							
Land	NA	$ 6 598	$ 6 598	$ 7 137	$ 7 380[e]	$ 7 481[e]	$ 7 502[e]
Buildings	0	21 290	23 044	27 391	52 352	62 140	63 212
Other structures and facilities	0	13 084	9 314[f]	15 122	20 253	22 987	24 251
Real property	NA	$40 972	$38 956	$49 650	$79 985	$92 608	$94 965
Capitalized equipment[g]	NA	NA	NA	NA	NA	NA	$41 338

[a] Until July 1, 1965, this component field installation was designated Michoud Operations. For definition of terms, see introduction to Chapter Two.

[b] Originally reported as 341.6 hectares (844 acres) until resurveyed in 1963.

[c] 26.6 hectares (65.8 acres) acquired during FY 1965 through transfer from U.S. Army.

[d] Although number of buildings dropped, square footage increased because of redefinition of buildings.

[e] Clearing, grubbing, landscaping, grading, seeding, and additions of trees and shrubbery added to land value.

[f] Value of other structures and facilities dropped $3 770 600 during FY 1964 because of redefinition.

[g] Integral equipment value is included with that of the building or facility where it is physically located; collateral equipment is included in MSFC figures.

NA = Data not available.

Source: NASA, Office of Facilities. Supplementary information was provided by T. M. Cobb.

Table 6-113. Property: Computer Operations Office
(as of June 30; money amounts in thousands)

Category[a]	1963	1964	1965	1966	1967	1968
Land in hectares (and acres)						
Owned	5.7 (14)	5.7 (14)	5.7 (14)	5.7 (14)	5.7 (14)	5.7 (14)
Leased	0	0	0	0	0	0
Buildings						
Number owned	3	4	5	5	5	5
Area owned, thousands of sq m (and sq ft)	6.0 (65)	5.8 (62)	6.3 (68)	6.3 (68)	10.2 (110)	10.2 (110)
Area leased	0	0	0	0	0	0
Value						
Land	$ 52	$ 52	$ 61[b]	$ 61[b]	$ 63[b]	$ 63
Buildings	2251	2849	2844	2907	4380	4406
Other structures and facilities	617	434[c]	702	703	814	824
Real property	$2920	$3335	$3607	$3671	$5257	$5293
Capitalized equipment[d]	NA	NA	NA	NA	NA	$ 311

[a] For definition of terms, see introduction to Chapter Two.

[b] Clearing, grubbing, landscaping, grading, seeding, and additions of trees and shrubbery added to land value.

[c] Value of other structures and facilities dropped $183 000 during FY 1964 because of redefinition.

[d] Integral equipment value is included with that of the building or facility where it is physically located; collateral equipment is included in MSFC figures.

NA = Data not available.

Source: NASA, Office of Facilities.

Table 6–114. Property: Mississippi Test Facility
(as of June 30; money amounts in thousands)[a]

Category	1963[b]	1964	1965	1966	1967	1968
Land in hectares (and acres)						
Owned	6 001.5 (14 830)	8 061.3 (19 920)	8 492.7 (20 986)	8 492.7 (20 986)	8 492.7 (20 986)	8 492.7 (20 986)
Leased	0	0	0	0	0	0
Buildings						
Number owned	NA	22	NA	17	41	106[d]
Area owned, thousands of sq m (and sq ft)	0	4.6 (49)	2.8 (30)	43.1 (464)	50.8 (547)	85.4 (919)
Area leased	0	0	0	0	0	0
Value						
Land	$4472	$15 370	$ 9 726[d]	$ 9 774	$ 10 144	$ 15 224
Buildings	0	617	687	11 337	48 795	61 394
Other structures and facilities	0	5 545	12 189	30 151	69 345	152 625
Real property	$4472	$21 532	$22 602	$51 262	$128 284	229 243
Capitalized equipment	NA	NA	NA	NA	NA	$ 24 846

[a] Until July 1, 1965, facility was designated Mississippi Test Operations. For definition of terms, see introduction to Chapter Two.

[b] The land acquisition program began FY 1963. After gradual completion of court actions, by the end of FY 1965, 13 428 acres in the test area and 3058.6 hectares (7558 acres) in the buffer zone had been acquired by the Government.

[c] Adjusted figure; 98.7 additional hectares (244 acres) in rights-of-way appeared in end-of-fiscal-year reports.

[d] Large increase because trailers were included in buildings category in FY 1968.

NA = Data not available.

Source: NASA, Office of Facilities.

Table 6-115. Value of Real Property Components as Percentage of Total Including Huntsville, Component Installations, and Industrial Property
(as of June 30; total real property value in thousands)

Component	1961	1962	1963	1964	1965	1966	1967	1968
Land	0.2	0.2	10.7	17.1	8.2	6.8	5.3	4.9
Buildings	98.2	98.0	70.4	63.6	51.5	56.5	55.2	46.9
Other structures and facilities	1.6	1.8	18.9	19.3	40.3	36.7	39.5	48.2
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total MSFC real property value	$36 818	$40 037	$104 610	$129 063	$210 580	$286 576	$409 722	$538 362

Source: Derived from Tables 2-10 through 2-13 in Chapter Two.

Table 6-116. Value of Real Property Components as Percentage of Total Including Huntsville and Industrial Property
(as of June 30; total real property value in thousands)[a]

Component	1961	1962	1963	1964	1965	1966	1967	1968
Land	0.2	0.2	0.2	0.1	0.3	1.4	2.2	1.8
Buildings	98.2	98.0	89.1	85.1	57.6	63.0	60.3	58.9
Other structures and facilities	1.6	1.8	10.7	14.8	42.1	35.6	37.5	39.3
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total Huntsville and industrial real property value	$36 818	$40 037	$56 246	$65 240	$134 721	$151 658	$183 573	$208 861

[a] Does not include component installations.

Source: Derived from Tables 2-10 through 2-13 in Chapter Two.

Table 6-117. Value of Real Property Components as Percentage of Total: Michoud Assembly Facility
(as of June 30; total real property value in thousands)

Component	1963	1964	1965	1966	1967	1968
Land	16.1	16.9	14.4	9.2	8.1	7.9
Buildings	52.0	59.2	55.2	65.5	67.1	66.6
Other structures and facilities	31.9	23.9	30.4	25.3	24.8	25.5
	100.0	100.0	100.0	100.0	100.0	100.0
Total Michoud real property value	$40 972	$38 956	$49 650	$79 985	$92 608	$94 965

Source: Derived from Tables 2-10 through 2-13 in Chapter Two.

Table 6-118. Value of Real Property Components as Percentage of Total: Computer Operations Office
(as of June 30; total real property value in thousands)

Component	1963	1964	1965	1966	1967	1968
Land	1.8	1.6	1.7	1.7	1.2	1.2
Buildings	77.1	85.4	78.8	79.2	83.3	83.3
Other structures and facilities	21.1	13.0	19.5	19.1	15.5	15.5
	100.0	100.0	100.0	100.0	100.0	100.0
Total Computer Operations real property value	$2920	$3335	$3607	$3671	$5257	$5293

Source: Derived from Tables 2-10 through 2-13 in Chapter Two.

Table 6-119. Value of Real Property Components as Percentage of Total: Mississippi Test Facility
(as of June 30; total real property value in thousands)

Component	1963	1964	1965	1966	1967	1968
Land	100.0	71.4	43.0	19.1	7.9	6.6
Buildings	0	2.9	3.1	22.1	38.1	26.9
Other structures and facilities	0	25.7	53.9	58.8	54.0	66.5
	100.0	100.0	100.0	100.0	100.0	100.0
Total MTF real property value	$4472	$21 532	$22 602	$51 262	$128 284	$229 243

Source: Derived from Tables 2-10 through 2-13 in Chapter Two.

Table 6-120. Personnel[a]

Employee Category	1960		1961		1962		1963	
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31
Requested for FY ending			5500		5960		7200	
Total paid employees	370	5367	5948	6034	7182	6844	7332	7227
Permanent	320	5248	5521	5911	6669	6658	7243	7145
Temporary	50	119	427	123	513	186	89	82
Code group (permanent only)								
200[b]	15	535	51	12	35	52	63	74
700[c]	0	951	1663	1843	2159	2282	2423	2516
900	0	0	0	0	0	0	0	0
Subtotal	15	1486	1714	1855	2194	2334	2486	2590
600[d]	0	273	316	422	579	595	706	728
500	224	816	870	968	1126	1081	1203	1175
300	74	748	857	932	1077	1033	1283	1122
100	7	1925	1764	1734	1693	1615	1565	1530
Subtotal	305	3762	3807	4056	4475	4324	4757	4555
Excepted: on duty	3	43	48	47	54	55	53	54
Accessions: permanent	321	965	628	634	1091	762	1260	649
Accessions: temporary	53	181	446	81	534	292	267	217
Military detailees	0	11	16	20	25	22	31	43

Table 6-120. Personnel[a] (Continued)

Employee Category	1964		1965		1966		1967		1968
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Requested for FY ending	7492		7464		7489		7221		7030
Total paid employees	7679	7639	7719	7503	7740	7434	7602	7288	6935
Permanent	7467	7517	7485	7409	7416	7342	7153	7026	6400
Temporary	212	122	234	94	324	92	449	262	535
Code group (permanent only)									
200[b]	63	59	55	47	48	47	43	44	36
700[c]	2672	2729	2696	2649	2692	2726	2731	2747	2570
900	0	0	0	0	0	0	0	0	0
Subtotal	2735	2788	2751	2696	2740	2773	2774	2791	2606
600[d]	827	846	874	896	1055	1132	1147	1166	1000
500	1297	1295	1310	1331	1290	1224	1211	1101	1051
300	1131	1138	1126	1140	1092	1067	956	1000	908
100	1477	1450	1424	1346	1239	1146	1065	968	835
Subtotal	4732	4729	4734	4713	4676	4569	4379	4235	3794
Excepted: on duty	56	52	40	38	38	39	40	40	40
Accessions: permanent	836	799	473	683	704	444	443	NA	NA
Accessions: temporary	741	167	193	487	294	165	348	NA	NA
Military detailees	46	50	44	37	32	27	26	21	23

[a] NASA Huntsville Facility was officially established as a field installation March 14, 1960, and was designated George C. Marshall Space Flight Center the following day. Transfer of personnel to NASA from ABMA's Development Operations Division was effective July 1, 1960. Figures in this table include personnel at component installations.

[b] Beginning June 30, 1961, the data reflect conversion of some professionals from the 200 Code group (engineers) to the 700 Code group (aerospace technologists). For key to Code group numbers and definition of terms, see Chapter Three.

[c] Data before June 30, 1961, are for "aeronautical research scientists." Beginning June 30, 1961, the data reflect conversion of these personnel to the 700 Code group (aerospace technologists).

[d] Before Dec. 31, 1960, the data reflect inclusion of Code group 600 personnel in the 500 Code group.

NA = Data not available.

Source: NASA, Personnel Office. Data through Dec. 31, 1966, from NASA Quarterly Personnel Statistical Report; data after Dec. 31, 1966, from NASA Personnel Management Information System and the NASA Supplement to SF 113-A, "Monthly Report of Federal Civilian Employment Short Form."

Table 6-121. Personnel: Michoud Assembly Facility[a]

Employee Category	1961	1962		1963		1964		1965		1966		1967		1968
	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Total, paid employees	16	64	121	207	251	285	282	283	278	284	257	251	232	166
Permanent	16	64	118	206	251	280	281	281	278	280	256	248	231	163
Temporary	0	0	3	1	0	5	1	2	0	4	1	3	1	3

[a] Includes personnel at Computer Operations Office, Slidell, La.

Source: MSFC, Manpower Utilization and Administration Office.

Table 6-122. Personnel: Mississippi Test Facility

Employee Category	1963		1964		1965		1966		1967		1968
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Total, paid employees	24	35	44	47	87	115	105	105	105	97	103
Permanent	22	34	43	44	68	98	97	102	97	94	88
Temporary	2	1	1	3	19	17	8	3	8	3	15

Source: MSFC, Manpower Utilization and Administration Office.

Table 6-123. Distribution of Permanent Personnel Positions by Fiscal Year and Budget Activity[a]

Program	1960[b]	1961	1962	1963	1964	1965	1966	1967	1968
Manned space flight		4625	5137	4709	5453	5544	5329	5168	4790
(% of total)	(90.0)	(86.4)	(83.7)	(69.0)	(72.7)	(73.8)	(73.3)	(72.9)	(74.4)
Space applications		8	0	1	0	0	2	3	6
(% of total)	(0.0)	(0.1)	(0.0)	(*)	(0.0)	(0.0)	(*)	(*)	(0.1)
Unmanned investigations in space		429	651	3	31	15	18	77	32
(% of total)	(0.0)	(8.0)	(10.6)	(*)	(0.4)	(0.2)	(0.3)	(1.1)	(0.5)
Space research and technology		293	330	495	351	287	316	331	283
(% of total)	(10.0)	(5.5)	(5.4)	(7.3)	(4.7)	(3.8)	(4.3)	(4.7)	(4.4)
Aircraft technology		0	0	2	0	0	0	0	0
(% of total)	(0.0)	(0.0)	(0.0)	(*)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Supporting activities[c]		0	17	1611	1667	1664	1606	1507	1329
(% of total)	(0.0)	(0.0)	(0.3)	(23.6)	(22.2)	(22.2)	(22.1)	(21.3)	(20.6)
Total		5355	6135	6821	7502	7510	7271	7086	6440

[a] Based on number of actual positions reported in annual NASA Budget Estimates. FY 1961 actual figure was reported in NASA, *Budget Estimates, FY 1963;* FY 1962 actual figure was reported in NASA, *Budget Estimates, FY 1964*, etc.

[b] Actual positions data are not available for FY 1960. Percentages in this column are based on distribution used by NASA Office of Programming, Budget Operations Division, in preparing *History of Budget Plans, Actual Obligations, and Actual Expenditures for Fiscal Years 1959 Through 1963* (Washington, D.C.: NASA, 1965), Sect. 8.

[c] FY 1963 and later figures include tracking and data acquisition, technology utilization, and general support positions. Until FY 1963 support positions were reported with the five other budget activities. FY 1962 figure represents tracking and data acquisiton plus technology utilization (reported as "industrial applications").

* = Less than 0.05%

Source: NASA, *Budget Estimates,* FY 1963–FY 1969; NASA, Budget Operations Division.

Table 6-124. Funding by Fiscal Year
(program plan as of May 31, 1968; in millions)

Appropriation Title	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total
Research and development	$4.50	$295.20	$505.50	$ 804.50	$1301.40	$1474.00	$1549.90	$1342.10	$1092.60	$8369.70
Construction of facilities[a]										
Marshall	0	26.18	30.03	40.61	28.24	12.30	1.96	0	0.74	140.06
Michoud Assembly Facility	0	0	10.12	28.55	7.58	6.45	0.30	0.70	0.42	54.12
Mississippi Test Facility	0	0	23.36	76.25	103.38	58.51	0	0	0	261.50
Administrative operations[b]	5.07	68.58	89.18	112.23	124.31	138.68	128.51	128.23	123.22	918.01
Total	$9.57	$389.96	$658.19	$1062.14	$1564.91	$1689.94	$1680.67	$1471.03	$1216.98	$9743.39

[a] Does not include facilities planning and design.

[b] FY 1960–1962 appropriations were for salaries and expenses; FY 1963 appropriation was for research, development, and operation.

Source: NASA, Office of Programming, Budget Operations Division, *History of Budget Plans, Actual Obligations, and Actual Expenditures for Fiscal Years 1959 Through 1963* (Washington, D.C.: NASA, February 1965); NASA, Budget Operations Division, "Status of Approved Programs," FY 1959–FY 1968, May 1968.

Table 6-125. Actual Obligations for Construction of Facilities by Fiscal Year and Program Year
(in millions)

Program Year	Program Plan[a]	FY 1961	FY 1962	FY 1963	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	Total
1961	$ 26.2	$11.7	$13.9	$ 0.3	*	$ 0.1	*	0	0	$ 26.2
1962	31.2		12.9	17.1	$ 0.6	0.6	*	-*	-*	31.2
1963	42.0[b]			28.9	9.8	2.7	$0.5	*	*	41.9[b]
1964	29.1				13.3	14.0	1.3	$0.3	*	28.9
1965	12.6					9.6	1.9	0.9	*	12.4
1966	2.0						1.6	0.2	*	1.9
1967	0.1							0	*	*
1968	0.7								0	0
Total	$143.9	$11.7	$26.9	$46.2	$23.8	$27.1	$5.3	$1.4	$0.1	$142.5

[a] As of June 30, 1968; includes facilities planning and design.

[b] Does not include $3.8 million programmed (PY 1963) and obligated for Advanced Saturn Dynamic Test Facility which was reported with "various locations."

* = Less than $100 000. Because of rounding, columns and rows may not add to totals.

Source: NASA, Budget Operations Division, "Status of Approved Programs, Construction of Facilities," FY 1959–FY 1968, June 1968; NASA, Financial Management Division, "Summary Financial Status of Programs," June 30, 1968.

Table 6–126. Actual Obligations for Construction of Facilities by Fiscal Year and Program Year: Michoud Assembly Facility Including Computer Operations Office
(in millions)

Program Year	Program Plan[a]	FY 1962	FY 1963	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	Total
1962	$11.1[b]	$5.0	$ 4.9	$ 1.1	-*	*	0	-*	$11.0[b]
1963	29.0		19.8	8.8	$ 0.4	*	*	-*	29.0
1964	7.9			2.0	5.5	$0.2	-*	0	7.6
1965	6.6				4.8	1.5	*	0	6.3
1966	0.3					0.3	*	0	0.3
1967	0.8						$0.5	$0.1	0.6
1968	0.5							0.5	0.5
Total	$56.2	$5.0	$24.7	$11.8	$10.7	$2.1	$0.5	$0.5	$55.3

[a] As of June 30, 1968; includes facilities planning and design.

[b] Includes $367 000 programmed (PY 1962) and obligated for Slidell facility which was reported under "various locations."

* = Less than $100 000. Because of rounding, columns and rows may not add to totals.

Source: NASA, Budget Operations Division, "Status of Approved Programs, Construction of Facilities," FY 1959–FY 1968, June 1968; NASA, Financial Management Division, "Summary Financial Status of Programs," June 30, 1968.

Table 6-127. Actual Obligations for Construction of Facilities by Fiscal Year and Program Year: Mississippi Test Facility
(in millions)

Program Year	Program Plan[a]	FY 1962	FY 1963	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	Total
1962	$ 23.5	$5.0	$13.9	$ 3.5	0	0	0	$0.6	$ 23.1
1963	80.8		58.1	19.0	$ 1.0	$ 2.6	-*	-0.2	80.4
1964	105.2			79.5	11.9	12.2	$1.0	-0.1	104.5
1965	58.6				54.1	4.1	0.3	-*	58.4
1966	0					0	0	0	0
1967	0						0	0	0
1968	0							0	0
Total	$268.1	$5.0	$72.0	$101.9	$67.1	$18.9	$1.3	$0.0	$266.2

[a] As of June 30, 1968; includes facilities planning and design.

* = Less than $100 000. Because of rounding, columns and rows may not add to totals.

Source: NASA, Budget Operations Division, "Status of Approved Programs, Construction of Facilities," FY 1959-FY 1968, June 1968; NASA, Financial Management Division, "Summary Financial Status of Programs," June 30, 1968.

Table 6-128. Total Procurement Activity by Fiscal Year
(money amounts in millions)

	1961	1962	1963	1964	1965	1966	1967	1968	Total
Net value of contract awards	$257.8	$595.6	$949.8	$1378.1	$1689.9	$1587.3	$1304.9	$1088.3	$8851.7
Percentage of NASA total	34%	39%	29%	30%	32%	31%	28.1%	26.3%	30.0%

Source: NASA, Procurement and Supply Division, *NASA Procurement: October 1, 1958 to June 30, 1960* (Washington, D.C.: NASA, September 1960); NASA, *Annual Procurement Report*, Fiscal Years 1961-1968 (Washington, D.C.: NASA, 1962-1968).

Table 6–129. Awards to Personnel Granted under Section 306 of the Space Act of 1958[a]

Year	Inventor	Contribution	Amount
1963	Curt P. Herold	Multiple quick disconnector	$1000
1966	Manfred E. Kuebler	Nutation damper for satellites	$1500
1968	Clayton Loyd John R. Rasquin Hubert E. Smith Charles D. Stocks	Precision electronic control for orbital tube flaring machines	$ 500
	Helmut G. L. Krause	Theory of a refined earth figure model and theory of a refined earth figure model with applications	$ 500
	Daniel W. Gates with Gene A. Zerlaut and Frederick O. Rogers, IIT Research Inst.	Synthesis of zinc titanate pigment and coatings containing the same	$ 300

[a] For complete listing of awards under this Act, see Appendix B, Section 1.B.

Source: NASA, Inventions and Contributions Board.

AEC—NASA SPACE NUCLEAR PROPULSION OFFICE

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AEC—NASA
SPACE NUCLEAR PROPULSION OFFICE (SNPO)

Location: Germantown, Montgomery County, Maryland.

Manager: Milton Klein (March 15, 1967-).
Harold B. Finger (Aug. 31, 1960-March 15, 1967).

Deputy Manager:
David S. Gabriel (May 15, 1967-).
Milton Klein (August 1960-March 1967).

History

On August 29, 1960, NASA and the Atomic Energy Commission signed an agreement establishing a single project office combining NASA and AEC personnel who would be responsible for all aspects of the nuclear rocket program. Coresponsibility with AEC for this program, Project Rover, had been transferred from the Air Force to NASA by President Eisenhower's Executive Order 10783 establishing NASA October 1, 1958.[1]

Under the terms of this agreement, AEC had primary responsibility for "research and development of nuclear reactors and reactor components including those required for aeronautical or space missions specified by NASA." NASA had primary responsibility for conducting research and development on "components and subsystems of nuclear systems other than the reactor, reactor components and isotope power units, and for integration of the reactor into nuclear propulsion systems and nuclear electric power generation systems."[2] AEC and NASA announced these terms and the establishment of the joint AEC-NASA Nuclear Propulsion Office (NPO) August 31, 1960.[3] On February 1, 1961, a second agreement outlined contract administration responsibilities of the Nuclear Propulsion Office and

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[1] Memorandum of Understanding, signed by John A. McCone, Chairman, U.S. Atomic Energy Commission, and T. Keith Glennan, NASA Administrator, Aug. 29, 1960; NASA-AEC Release 60-252.

[2] Memorandum of Understanding, Aug. 29, 1960.

[3] NASA-AEC Release 60-252.

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called for establishment of jointly staffed field extensions in Cleveland and Albuquerque.[4]

President Kennedy, in his address to Congress May 25, 1961, asked for a $23-million supplement to the FY 1962 budget for acceleration of the Rover program, saying it gave "promise of some day providing a means for even more exciting and ambitious exploration of space [than the manned lunar landing program], perhaps beyond the moon, perhaps to the very ends of the solar system itself."[5] The May budget amendment as approved by Congress made $22 million in new obligational authority available for the NASA nuclear systems program—$8 million for research and development and $15 million for construction of facilities.[6] On July 28, 1961, a third AEC-NASA agreement defined more specifically the responsibilities of AEC, NASA, and the joint office, which was renamed the AEC-NASA Space Nuclear Propulsion Office.[7]

Studies of requirements for a national nuclear rocket engine development facility had been initiated in October 1960, and a contract was issued for design of an engine maintenance and disassembly building in August 1961.[8] On February 19, 1962, NASA and AEC announced that the Jackass Flats area of the AEC's Nevada Test Site, about 144.8 kilometers (90 miles) north of Las Vegas, was designated Nuclear Rocket Development Station (NRDS) under the overall management of the Space Nuclear Propulsion Office. Test facilities of the AEC's Los Alamos Scientific Laboratory (LASL), where Kiwi-A reactors had been tested since July 1959, were on the site.[9]

The third and final test in the Kiwi-A series was conducted October 19, 1960. The first test of the Kiwi-B reactor, intended to lead to designs for the NERVA engine (Nuclear Engine for Rocket Vehicle Application), was performed in December 1961. On November 30, 1962, a power test of the first flight reactor, Kiwi-B4A, was terminated when bright flashes appeared in the exhaust. Investigation showed that flow-induced vibrations had damaged the reactor. After a year and a half of redesign, analysis, and component and cold-flow testing, the Kiwi-B4D was tested successfully May 13, 1964, at power and temperature conditions exceeding planned test conditions, a major milestone in the development program.[10]

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[4] "Agreement Between NASA and AEC on Management of Nuclear Rocket Engine Contracts," signed by NASA Associate Administrator Robert C. Seamans, Jr., and AEC General Manager Alvin R. Luedecke, Feb. 1, 1961.

[5] *Public Papers of the Presidents of the United States: John F. Kennedy, 1961* (Washington, D.C.: GPO, 1962), 404.

[6] Rosholt, *Administrative History of NASA*, Table 6.1, 195.

[7] "Inter-Agency Agreement Between the Atomic Energy Commission and the National Aeronautics and Space Administration for the Rover Program 1961," signed by NASA Associate Administrator Robert C. Seamans, Jr., and AEC General Manager A. R. Luedecke, July 28, 1961; NASA General Management Instruction No. 2-3-17, July 28, 1961.

[8] NASA-AEC Release 60-319; NASA Release 61-193.

[9] NASA-AEC Release 62-37.

[10] SNPO Release 61-33; Speech, Harold B. Finger before 26th Annual Meeting and News Conference of the Aviation/Space Writers' Association, Miami, Fla., May 29, 1964.

On September 10, 1964, in the final Kiwi test, the Kiwi-B4E, which had operated for eight minutes August 28, was restarted and run for 2.5 minutes at near design power, the first demonstration of restart capability. Two weeks later, on September 24, the NERVA NRX-A2 reactor was operated for six minutes in its first power test, showing an equivalent vacuum specific impulse of approximately 760 seconds. The NRX-A2 was restarted and run for 20 minutes October 15, 1964, to investigate the margin of control in low-flow, low-power operation.[11]

Between April 23 and May 28, 1965, the NRX-A3 reactor accumulated 23.5 minutes of full-power operation in three tests. The initial Phoebus 1-A test, in a series of small graphite reactor ground tests to obtain data for design of the large-diameter Phoebus-2 series, was conducted June 25, 1965. The reactor operated successfully at full power for 10.5 minutes but was damaged by overheating during shutdown when the facility liquid-hydrogen supply was unexpectedly exhausted.[12]

In a series of engine-system power tests of a breadboard version of NERVA between February 3 and March 25, 1966, the engine system was started 10 times and accumulated 29 minutes at nominal full power. The NRX-A5 reactor was operated and restarted in June 1966 for a total of 30 minutes of full-power operation.[13]

A Phoebus-1B reactor test February 23, 1967, accumulated 30 minutes at above 1250 megawatts, and Phoebus-2 cold-flow tests were conducted between July 12 and July 19, 1967. In the final system test in the reactor portion of the NERVA technology program, the NRX-A6 reactor was operated for 60 minutes at design power December 15, 1967. This duration at full power was twice as long as that of any previous reactor, and the test achieved one of the basic technological goals of the graphite reactor and engine system development program—exploration of the corrosion behavior of reactor components for 60 minutes at full power. By early 1968, the nine consecutive reactors had accumulated a total test time of seven hours of power operation, with more than three hours at or near design power. Ground experimental engine tests were scheduled for mid-1968.[14]

Mission

The Space Nuclear Propulsion Office was assigned responsibility for providing necessary research, design, and engineering data; test hardware; and general technology to develop nuclear rocket systems with power levels, operating times, restart conditions, and specific impulse values suitable for advanced space-exploration missions; management of Nuclear Rocket Development Station (NRDS), Jackass Flats, Nevada, for ground static-testing of reactors, engines, and, eventually, vehicles associated with nuclear rocket development.[15]

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[11] Harold B. Finger, "Space Nuclear Propulsion Mid-Decade," *Astronautics and Aeronautics* (January 1965), 30-35.

[12] AEC, *Major Activities in the Atomic Energy Programs, 1965* (Washington, D.C.: AEC, 1966), 145; SNPO-N Release 65-9.

[13] AEC, *Major Activities in the Atomic Energy Programs, 1966* (Washington, D.C.: AEC, 1967), 186; U.S. Congress, House, Committee on Science and Astronautics, Subcommittee on Advanced Research and Technology, *1968 NASA Authorization, Hearings*, Pt. 4, 90th Cong., 1st sess., March 14-22, April 4-20, 1967 (Washington, D.C.: GPO, 1967), 958 ff.

[14] *Ibid.*, 963; AEC, *Major Activities in the Atomic Energy Programs, 1967* (Washington, D.C.: AEC, 1968), 161 ff.; U.S. Congress, House, Committee on Science and Astronautics, Subcommittee on Advanced Research and Technology, *1969 NASA Authorization, Hearings*, Pt. 4, 90th Cong., 2d sess., Feb. 19-22, 26-29, 1968 (Washington, D.C.: GPO, 1968), 271 ff.

SPACE NUCLEAR PROPULSION OFFICE-ALBUQUERQUE (SNPO-A)

Location: Albuquerque, Bernalillo County, New Mexico (on grounds of Sandia Base, New Mexico).

Chief: Jack F. Cully (Oct. 27, 1961-).

History

On February 1, 1961, NASA and AEC agreed to establish a field extension of the Nuclear Propulsion Office at AEC facilities at Albuquerque. The Albuquerque Extension was to serve as liaison with the AEC's Los Alamos Scientific Laboratory, which had begun development work on nuclear rockets in April 1955 and initiated testing of the Kiwi-A reactor series in July 1959.[16] The office was also responsible for directing the work of contractors as assigned by the SNPO, using the technical advice and assistance of Los Alamos Scientific Laboratory and Lewis Research Center.

SPACE NUCLEAR PROPULSION OFFICE-CLEVELAND (SNPO-C)

Location: Cleveland, Cuyahoga County, Ohio (on grounds of Lewis Research Center).

Chief: Robert W. Schroeder (March 1962-).
Lester C. Corrington (Acting Chief, October 1961-March 1962).

History

The NASA-AEC agreement of February 1, 1961, provided for establishment of a field extension of the Nuclear Propulsion Office at Cleveland. On

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[15] NASA, *Budget Estimates*, FY 1969, IV, AO 2-94.

[16] *Ibid.*; NASA-AEC Release S-5-63.

October 23, 1961, NASA announced activation of the Cleveland Extension to maintain technical liaison with Lewis Research Center, which conducted research and development in support of the nuclear rocket program. The Cleveland Extension was to direct the work of contractors as assigned by the SNPO Headquarters.[17]

SPACE NUCLEAR PROPULSION OFFICE-NEVADA (SNPO-N)

Location: Jackass Flats, Nye County, Nevada.

Land: Nuclear Rocket Development Station, 36 421.7 hectares (90 000 acres), AEC-owned.

Chief: John P. Jewett (July 2, 1967-).
Bob P. Helgeson (Aug. 1, 1962-April 22, 1967).

History

NASA and AEC announced February 19, 1962, that the Jackass Flats area of the AEC's Nevada Test Site had been designated the Nuclear Rocket Development Station.[18] In June NASA announced establishment of the Nevada Extension of the SNPO.[19] The new office, in Las Vegas, was responsible for managing construction and operation of the Nuclear Rocket Development Station. The Nevada Extension became operational October 5, 1962.[20] Work on the cold area of the Engine Maintenance, Assembly, and Disassembly (E-MAD) Building was completed in September 1967, and the hot-cell area was completed in December 1967 and used in post-test operations on the NRX-A6. The entire E-MAD disassembly area was used for the first time in disassembling the XE-1.[21]

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[17] Seamans-Luedecke Agreements Feb. 1, 1961, and July 28, 1961; NASA Announcement No. 384, Oct. 23, 1961.

[18] NASA-AEC Release 62-37.

[19] NASA Announcement No. 513, June 5, 1962; NASA Release, June 15, 1962.

[20] NASA Release 62-215.

[21] House, Committee. . ., *1969 NASA Authorization, Hearings*, Pt. 4, 283.

Table 6–130. Industrial Real Property: SNPO-Cleveland
(as of June 30; in thousands)

Air Force Industrial Plant #4 Fort Worth, Texas	1967	1968
Other structures and facilities value[a]	$125	$125
Total real property value	$125	$125

[a] No land or buildings. These figures are included in Table 6–131. Data for earlier years are not available.

Source: NASA, Office of Facilities.

Table 6–131. Property
(as of June 30; money amounts in thousands)

Category[a]	1965[b]	1966	1967	1968
Land in hectares (and acres)				
Owned	0	0	0	0
Leased	0	0	0	0
Buildings				
Number owned	2	8	9	9
Area owned, thousands of sq m (and sq ft)	0.5 (5)	17.0 (182)	17.2 (185)	17.2 (185)
Area leased	0	0	0	0
Value				
Land	0	0	0	0
Buildings	$ 71	$14 207	$14 525	$19 680
Other structures and facilities	21	1 809	8 586	5 235
Real property	$ 92	$16 016	$23 111	$24 915
Capitalized equipment	$434	$ 7 728	$24 075	$24 408

[a] For definition of terms, see introduction to Chapter Two.

[b] Data for earlier years are not available.

Source: NASA, Office of Facilities.

Table 6–132. Value of Real Property Components as Percentage of Total
(as of June 30; total real property value in thousands)

Component	1965[a]	1966	1967	1968
Land	0	0	0	0
Buildings	77.2	88.7	62.8	79.0
Other structures and facilities	22.8	11.3	37.2	21.0
	100.0	100.0	100.0	100.0
Total SNPO real property value	$92	$16 016	$23 111	$24 915

[a] Data for earlier years are not available.

Source: Derived from Tables 2–10 through 2–13 in Chapter Two.

Table 6–133. Personnel[a]

Employee Category	1961 12/31	1962 6/30	1962 12/31	1963 6/30	1963 12/31	1964 6/30	1964 12/31	1965 6/30	1965 12/31	1966 6/30	1966 12/31	1967 6/30	1967 12/31	1968 6/30
Requested for FY ending		23		50		160		103		116		115		117
Total paid employees	15	39	67	96	102	112	111	116	112	115	114	113	117	108
Permanent	15	39	66	94	101	107	110	115	112	114	114	112	115	108
Temporary	0	0	1	2	1	5	1	1	0	1	0	1	2	0
Code group (permanent only)														
200[a]	0	1	2	2	2	2	1	1	1	1	1	1	1	0
700	12	26	34	49	53	57	58	58	57	58	58	57	63	59
900	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	12	27	36	51	55	59	59	59	58	59	59	58	64	59
600	1	3	10	15	17	17	17	19	18	18	19	20	21	19
500	2	9	20	28	29	31	34	37	36	37	36	34	30	30
300	0	0	0	0	0	0	0	0	0	0	0	0	0	0
100	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	3	12	30	43	46	48	51	56	54	55	55	54	51	49
Excepted: on duty	0	2	2	2	3	3	3	2	2	2	2	2	3	3
Accessions: permanent	3	14	24	32	13	12	8	11	6	9	8	5	NA	NA
Accessions: temporary	0	0	2	2	0	4	0	1	0	2	0	0	NA	NA
Military detailees	0	1	1	0	0	0	0	0	0	0	0	0	0	0

[a] Beginning June 30, 1961, the data reflect conversion of some professionals from the 200 Code group (engineers) to the 700 Code group (aerospace technologists). For key to Code group numbers and definition of terms, see Chapter Three.

NA = Data not available.

Source: NASA, Personnel Division. Data through Dec. 31, 1966, from NASA Quarterly Personnel Statistical Report; data after Dec. 31, 1966, from NASA Personnel Management Information System and the NASA Supplement to SF 113–A, "Monthly Report of Federal Civilian Employment Short Form."

Table 6-134. Distribution of Permanent Personnel Positions by Fiscal Year and Budget Activity[a]

Program	1962	1963	1964	1965	1966	1967	1968
Space research and technology	40	91	106	110	110	110	103
(% of total)	(100.0)	(94.8)	(94.6)	(94.0)	(94.0)	(94.0)	(95.4)
Supporting activities[b]	0	5	6	7	7	7	5
(% of total)	(0.0)	(5.2)	(5.4)	(6.0)	(6.0)	(6.0)	(4.6)
Total	40	96	112	117	117	117	108

[a] Based on number of actual positions reported in annual NASA Budget Estimates. FY 1961 actual figure was reported in NASA, *Budget Estimates, FY 1963;* FY 1962 actual figure was reported in NASA, *Budget Estimates, FY 1964,* etc.

[b] FY 1963 and later figures include tracking and data acquisition, technology utilization, and general support positions. Until FY 1963 support positions were reported with the five other budget activities.

Source: NASA, *Budget Estimates,* FY 1963–FY 1969; NASA, Budget Operations Division.

Table 6–135. Funding by Fiscal Year
(program plan as of May 31, 1968, in millions)

Appropriation Title	1962	1963	1964	1965	1966	1967	1968	Total
Research and development	$19.30	$53.20	$60.30	$45.80	$50.10	$47.80	$42.00	$318.50
Construction of facilities[a]	8.48	11.53	4.22	0	0	0	0	24.23
Administrative operations[b]	0.28	0.97	1.50	1.68	1.84	2.01	2.07	10.35
Total	$28.06	$65.70	$66.02	$47.48	$51.94	$49.81	$44.07	$353.08

[a] Nuclear Rocket Development Station; does not include facilities planning and design.

[b] FY 1962 appropriation was for salaries and expenses; FY 1963 appropriation was for research, development, and operation.

Source: NASA, Office of Programming, Budget Operations Division, *History of Budget Plans, Actual Obligations, and Actual Expenditures for Fiscal Years 1959 through 1963* (Washington, D.C.: NASA, February 1965); NASA, Budget Operations Division, "Status of Approved Programs," FY 1959–FY 1968, May 1968.

Table 6-136. Actual Obligations for Construction of Facilities by Fiscal Year and Program Year
(in millions)

Program Year	Program Plan[a]	FY 1962	FY 1963	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	Total
1962[b]	$ 8.9	$0.7	$ 7.4	$0.4	*	$0.4	-*	-*	$ 8.9
1963	11.8		5.8	5.9	-*	-*	$0.3	-*	11.9
1964	4.2			1.7	$2.5	-*	0	$0.1	4.2
1965	0.6				0	0.6	*	0	0.6
1966	0.1					0	0.1	0	0.1
1967	2.6						1.9	0.5	2.4
1968	0							0	0
Total	$28.2	$0.7	$13.2	$8.0	$2.5	$0.9	$2.1	$0.6	$28.2

[a] As of June 30, 1968; includes facilities planning and design.

[b] $1.5 million was programmed and obligated for Project Rover and Nuclear Rocket Development Station facilities in PY 1960 under "various locations."

* = Less than $100 000. Because of rounding, columns and rows may not add to totals.

Source: NASA, Budget Operations Division, "Status of Approved Programs, Construction of Facilities," FY 1959–FY 1968, June 1968; NASA, Financial Management Division, "Summary Financial Status of Programs," June 30, 1968.

Table 6-137. Total Procurement Activity by Fiscal Year
(money amounts in millions)

	1962	1963	1964	1965	1966	1967	1968	Total
Net value of contract awards	$36.4	$84.3	$91.7	$79.7	$85.8	$85.2	$65.7	$528.8
Percentage of NASA total	2%	3%	2%	2%	2%	1.8%	1.6%	1.8%

Source: NASA, Procurement and Supply Division, *NASA Procurement: October 1, 1958 to June 30, 1960* (Washington, D.C.: NASA, September 1960); NASA, *Annual Procurement Report*, Fiscal Years 1961–1968 (Washington, D.C.: NASA, 1962–1968).

WALLOPS STATION

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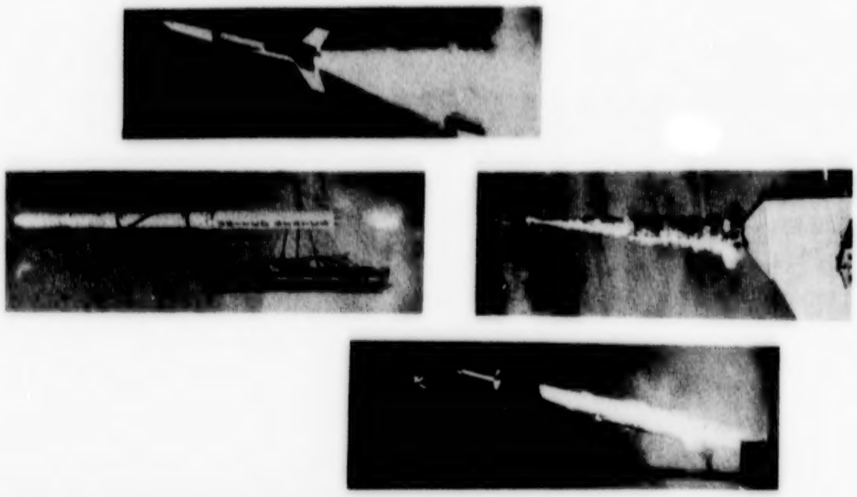

Wallops Station, Wallops Island, Virginia. On the Main Base (1967 photo cut in at left above), the right wing of the hangar building at lower right housed the Range Control Center, which monitored launchings from Wallops Island, eight kilometers (five miles) to the southeast (top, photographed in 1964). Launches from Wallops Island have included the NASA and Naval Research Laboratory *Explorer 37* satellite on a four-stage Scout March 5, 1968 (uppermost launch photo); the Astrobee 1500 solid-propellant sounding rocket (photographed, far right, in its second inflight performance test Oct. 21, 1964); the Nike-Apache 2 sounding rocket (carrying an International Year of the Quiet Sun experiment in 1964, at near right); and the Aerobee rocket (a 1960 tower launch at lower far right).

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WALLOPS STATION
(WS)

Location: Wallops Island, Accomack County, Virginia.

Land: 2680.4 total hectares (6623.5 acres) as of June 30, 1968:
- 2676.5 hectares (6613.7 acres) NASA-owned.
- 3.9 hectares (9.8 acres) leased.

Director: Robert L. Krieger (June 30, 1948-).

Associate Director:
Abraham D. Spinak (August 1966-).

History

In late 1944, recognizing the urgent military requirement for increased high-speed-missile research, Langley Memorial Aeronautical Laboratory organized a "Special Flying Weapons Team." At its first meeting, December 9, the need for "flight operation work" was mentioned.[1] Three members of the team were asked at the second meeting January 2, 1945, to draw up a formal proposal for an experimental station. This document, submitted to NACA Headquarters February 1, 1945, served as an operational and budget plan; a Langley-operated auxiliary flight research station had already been approved by the NACA, with two other facilities, on January 25.[2] These facilities were part of a request for supplemental appropriations and, after hearings March 16, Congress appropriated $4 100 000 April 25, 1945, for Langley facilities.[3]

The plan as approved had recommended Cherry Point, North Carolina, as a convenient location for the new facility. The site was under consideration by the Navy Bureau of Aeronautics for its main guided missile station, and the Bureau had promised the NACA full cooperation on high-speed research. During March, however, a Langley-USN group visited Cherry Point, and the declared opposition of the Marines to establishing the NACA station there led Langley representatives to look for a site in the Chincoteague area. A survey party selected Wallops Island, a narrow, 9.7-kilometer (6-mile) coastal strip off the eastern shore of Virginia.[4]

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[1] Joseph A. Shortal, "History of Wallops Station: Part One, Origin and Activities Through 1949," comment edition (NASA Wallops Station, 1967), 25, 30. The *Data Book* section on history of Wallops Station was prepared by Charles S. James, WS.

[2] NACA Executive Committee Minutes, Jan. 25, 1945; Memorandum, Langley Laboratory to NACA Headquarters, Request for Approval for Construction of an Auxiliary Flight Test Station, Feb. 1, 1945; Shortal, "History of Wallops," 25-26, 30.

[3] U.S. Congress, Senate Appropriations Subcommittee, *NACA First Deficiency Appropriations Bill, Hearings,* 79th Cong., 1st sess., March 16, 1945 (Washington, D.C.: GPO, 1945); U.S. Statute 58-374; Shortal, "History of Wallops," 32. This appropriation included $700 000 for a supersonic tunnel.

Named for John Wallop, a surveyor who had received a Crown Patent for the property from King Charles II of England in 1672, the 1295-hectare (3200-acre) island had been acquired in 1889 by the Wallops Island Association. The group, whose clubhouse on the beach was the only building on the island except for a Coast Guard Station, leased 1000 acres to the Government May 11, 1945. Although land acquisition was delayed by the Navy Bureau of Ordnance's intention to purchase the entire island, the NACA requested a land allotment at the southern end August 6, 1945. The Government took possession of 34.4 hectares (84.87 acres) September 18, and construction of permanent facilities began on the owned land. The facilities were not completed until early 1947.[5]

On May 7, 1945, the Auxiliary Flight Research Station was established as a unit of the Langley Memorial Aeronautical Laboratory (LMAL) Research Department.[6] Temporary facilities on Wallops were completed to launch eight 83-mm (3.25-inch) rockets in range checkout operations June 27, 1945. The Tiamat missile series began July 4 and continued through mid-1948. On October 17, 1945, a dummy RM-1 (Research Missile-1) was launched, beginning a series of 10 flights in which the first instrumented version was launched the following May. The first RM-2—launched October 18, 1945—initiated an extensive program to determine drag characteristics with simple models. In May 1946 an aerodynamic control program began, using RM-5 models, and a program studying drag of supersonic bodies was conducted in 1947 under the RM-6 and RM-10 projects.[7]

Auxiliary Flight Research Station became a division of the Langley Research Department June 10, 1946, and was redesignated Pilotless Aircraft Research Division (PARD).[8] With the formal organization of PARD August 11, the Wallops facility was placed under its operations section and named Pilotless Aircraft Research Station (PARS); its employees called the station "Wallops."[9]

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[4] Shortal, "History of Wallops," 25, 35-36; Memorandum, Ray W. Hooker to Engineer-in-Charge, Langley Memorial Aeronautical Laboratory (LMAL), April 26, 1945.

[5] Shortal, "History of Wallops," 43-44, 81.

[6] *Ibid.*, 39, 47; Memorandum, John W. Crowley, Chief of Research Dept. LMAL, May 7, 1945.

[7] Shortal, "History of Wallops," 55-56, 60-66, 69-71, 97-98, 101-103.

[8] *Ibid.*, 49; Memorandum, Floyd L. Thompson, Acting Chief of Research Dept., LMAL, July 10, 1946. Shortal notes that all guided missiles were then called "pilotless aircraft" by the Navy Bureau of Aeronautics and the Army Air Forces.

[9] Memorandum, Robert R. Gilruth, Chief, PARD, Aug. 15, 1946; Shortal, "History of Wallops," 50.

On April 25, 1947, a program of testing complete airplane configurations with the rocket-propelled model technique was initiated with launch of an AAF XF-91 model. Later configurations tested included practically all specific Air Force and Navy airplanes under development. Between April and August 1947 flight tests of the Deacon proved it to be a high-performance rocket motor, and it became the major rocket used in Wallops launchings. By early 1949 the Wallops Preflight Jet Wind Tunnel was in use for development of ramjet engines.[10]

A conflict with the Naval Aviation Ordnance Test Station (NAOTS) over interference with NACA activities on Wallops was resolved March 11, 1949, by an agreement establishing the NACA's primary interest in the area. This agreement made it possible for the NACA to request authority of the Bureau of the Budget for purchase of the island; previous requests had been turned down because of the Navy's intention to purchase the property, The request became part of the FY 1950 NACA appropriation bill, approved August 24, 1949. The Government took legal possession of the island November 7, and on December 4, 1949, the Attorney General officially notified the NACA of this action.[11]

In the summer of 1952, the NACA began moving formally toward space research. At a Wallops Island meeting in June, the NACA Committee on Aerodynamics approved a resolution that the NACA should intensify research on flight at 20- to 80-kilometer (12- to 50-mile) altitudes and speeds at mach 4 through mach 10 and "devote a modest effort to problems associated with unmanned and manned flight at altitudes from 50 miles [80 kilometers] to infinity" and speeds from mach 10 to earth escape velocity. This resolution was approved with slight revisions by the NACA Executive Committee July 14, 1952, and the laboratories were directed to begin studies on problems of space flight. Langley authorized research on a suitable manned vehicle.[12]

The same summer, the blunt-body concept had been developed at Ames Aeronautical Laboratory, and during the next few years the Pilotless Aircraft Research Division worked on multistage, solid-propellant rockets for studying heat transfer on variations of the blunt heatshield configuration. At Wallops August 20, 1953, PARD launched the first successful hypersonic research vehicle for heat transfer studies; it consisted of a cluster of three Deacons as first stage and an HPAG rocket second stage. The first launch of a three-stage rocket vehicle was performed at Wallops April 29, 1954, and on August 24, 1956, PARD launched the world's first five-stage solid-fuel rocket to a speed exceeding mach 15.[13]

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[10] Emme, *Aeronautics and Astronautics, 1915-1960,* 56; Shortal, "History of Wallops," 89-92, 100, 136-140, 164.

[11] U.S. Public Law 81-266, 63 Stat. 646, Aug. 24, 1949; Shortal, "History of Wallops," 118, 131.

[12] Minutes, NACA Committee on Aerodynamics, June 24, 1952, 19-21; NACA Executive Committee Minutes, July 14, 1952; Swenson, Grimwood, and Alexander, *This New Ocean*, 56-57.

[13] Swenson, Grimwood, and Alexander, *This New Ocean,* 65; Emme, *Aeronautics and Astronautics, 1915-1960,* 72, 74, 82.

The announcement that NASA would absorb the NACA as of October 1, 1958, stated that no change of name was contemplated for the Pilotless Aircraft Research Station.[14] Although the station had appeared as Pilotless Aircraft Research Station on a preliminary organization chart dated August 11, 1958, it was already entered as Wallops Station on the chart dated August 23, 1958, and all subsequent charts. On these early charts Wallops Station was under the proposed Space Flight Research Center; it first appeared as an independent installation on the chart dated May 1, 1959.[15]

On November 5, 1958, 14 personnel members from Langley's PARD were transferred to what later became the Space Task Group and continued their work on implementing a manned satellite project. Hardware for the project–designated Project Mercury November 26, 1958–included the PARD-designed Little Joe test booster, one of the earliest launch vehicles based on the rocket cluster principle. Little Joe was designed specifically for manned-capsule qualification tests. The first successful test in the series, conducted at Wallops Station, was October 4, 1959.[16]

In January 1959 NASA and the Navy signed an agreement transferring the Chincoteague Naval Air Station to NASA when deactivated by the Navy on July 1, 1959. This transfer added to Wallops Station property several thousand acres on the mainland, an area known as the Wallops Main Base.[17]

As part of a reentry physics program, Langley on March 3, 1959, launched the first in a series of six-stage, solid-fuel rockets to a speed of mach 26. Also from Wallops Station, the first complete Scout solid-propellant launch vehicle was launched July 1, 1960.[18] Between the launch of *Explorer 9* on February 16, 1961, and July 1968, 12 satellites were launched from Wallops by Scout vehicles, including 7 Explorers, 2 international satellites, and 3 for the Department of Defense.[19]

During the 1960s Wallops Station launched some 300 experiments every year to obtain information on the atmosphere and the space environment. In the period from 1945 through mid-1968, more than 6000 research vehicles were launched from Wallops Station.[20]

Mission

Wallops Station was assigned responsibility for preparation, assembly, and launch of scientific experimental payloads; correct positioning of the payloads in space at the proper velocity; tracking and data acquisition; including:

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[14] NACA Release, Sept. 26, 1958 (NASA Release No. 1).

[15] Rosholt, *Administrative History of NASA*, 48, 81, Fig. 3-1, and Append. B. The facility appeared as Pilotless Aircraft Research Station in NASA, *First Semiannual Report* (Washington, D.C.: GPO, 1959), 40, but the renaming was announced in NASA, *Second Semiannual Report* (Washington, D.C.: GPO, 1960), 94. Effective July 1, 1959, the official address was changed to NASA Wallops Station; see Memorandum, Joseph E. Robbins to distribution, June 22, 1959. NASA General Management Instruction 2-2-12, Sept. 17, 1959, established the functions of Wallops Station.

[16] NASA Release 59-235. For the role of Little Joe in Project Mercury, see Swenson, Grimwood, and Alexander, *This New Ocean*, especially 105, 124-125, and 208 ff.

[17] NASA Release, Jan. 24, 1959.

[18] Emme, *Aeronautics and Astronautics, 1915-1960*, 107, 124.

[19] NASA, "General Information, Wallops Station, Wallops Island, Virginia" (n.d.), 10.

[20] *Ibid.*, 2, 10; *Astronautics and Aeronautics, 1968*, NASA SP-4010.

(1) Preparation for flight of payloads designed and built by scientists and engineers in other NASA Centers, other Government agencies, U.S. colleges and universities, and the international scientific community;

(2) Testing and developing components and instrumentation for later experiments;

(3) Project management responsibility for the Owl series of University Explorers and for a Gravity Preference project;

(4) Management of the Experimental Inter-American Meteorological Rocket Network (EXAMETNET) and support for NASA's international cooperation program; conducting a Bio-Space Technology Training Program;

(5) Maintenance of offsite launch and tracking facilities—the Mobile Launch Facility, Mobile Sounding Rocket Facilities (for loan to other countries), Coquina Downrange Tracking Station, and the NASA Launch Facility at Point Barrow, Alaska.[21]

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[21] NASA, *Budget Estimates*, FY 1969, IV, AO 2-41, 2-42.

Table 6-138. Technical Facilities: Launch
(with costs in thousands)

Facility Name	Year Built	Init. Cost	Accum. Cost	Capability
Launch Area No. 2	1950	$ 213	$ 243	Hasp, Arcas, Universal, Nike-Ajax, Tubular, and I-beam launchers
Launch Area No. 4	1959	112	217	Nike-Ajax rail launcher and tubular launcher
Launch Area No. 1	1960	614	805	Aerobee launch tower; rocket and payload checkout
Launch Area No. 5	1960	163	210	Tubular launcher
Blockhouse No. 3	1960	784	788	Electrical ground support for Launch Areas 3, 4, and 5
Launch Area No. 3	1961	1135	1135	Scout assembly and launch
Sounding Rocket Facilities (Mobile)	1963	-[a]	113	Sounding rocket launching, tracking, and data acquisition[b]
Mobile Range Facility	1964	2500	3500	Instrumentation vans and semitrailers for launch of Nike-Cajun and Nike-Apache vehicles anywhere in the world
NASA Launch Facility (Point Barrow, Alaska)[c]	1965	345	345	Meteorological rocket grenade experiments with Nike-Cajun vehicles

[a] Surplus.

[b] On loan to India, Pakistan, Argentina, Brazil, and Spain.

[c] Buildings and grounds maintained by Arctic Research Laboratory of Univ. of Alaska.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), I, Sect. 9.

Table 6–139. Technical Facilities: Radar and Tracking
(with costs in thousands)

Facility Name	Year Built	Init. Cost	Accum. Cost	Technological Area Supported
MPS–19 Radar	1954	$ 200	$ 300	Wind weighting and initial acquisition for slaving purposes in support of ionospheric sounding rockets, probes, reentries, and orbital missions
FPS–16 Radar	1958	1200	2000	Precision analog and digital trajectory data for real-time and postflight analysis
JAFNA Facility	1959	1500	2000	Target analysis at L-band, S-band, and X-band in support of USAF Clear Air Turbulence Program and NASA reentry programs
SPANDAR Radar	1961	2000	3000	Precision analog and digital trajectory data for real-time and postflight analysis
136 MHz Tracking Antenna	1961	150	20	Reception of horizontal or vertical linear or circular polarized signals; transmittal of up to 250 watts of radio frequency power in the 148- to 150-MHz range
Coquina Downrange Tracking Station[a]	1961	320	444	Telemetry, communications, optical, and photographic systems for downrange support
FPQ–6 Radar	1964	3700	4500	Precision analog and digital trajectory data for real-time and postflight analysis

[a] Coquina Beach, N.C.; contractor-operated (Philco).

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), I, Sect. 9.

Table 6-140. Technical Facilities: Telemetry
(with costs in thousands)

Facility Name	Year Built	Init. Cost	Accum. Cost	Technological Area Supported
FM/AM Telemetry Facility	1958	$ 50	$ 20	Ground reception, conversion, and recording of FM/AM telemetry signals
High and Medium Gain Telemetry Facility	1961	500	700	Data acquisition in the 215 to 260 mc range
FM/FM Telemetry Facility	1961	400	1000	Reception, detection, demodulation, and display and recording of FM/FM telemetry data
X-Band Telemetry System[a]	1962	150	200	Tracking and reception of X-band telemetry, primarily for spacecraft reentry experiments
Digital Telemetry Facility	1967	800	–[b]	Input of PCM, PAM/PDM, and analog telemetry data
Advanced Data Acquisition System	1967	1810	–[c]	Reception of telemetry RF signals in the 220-260 mc-band, L-band, S-band, and X-band
High Power Telemetry Command System	1967	135	–[b]	Commands for vehicles and satellites in the 147-157 mc band

[a] At Wallops Island, Coquina Beach, N.C., and Bermuda Tracking Station.

[b] Authorized.

[c] Under construction.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), I, Sect. 9

Table 6-141. Technical Facilities Other Than Launch, Radar and Tracking, Telemetry
(with costs in thousands)

Facility Name	Year Built	Init. Cost	Accum. Cost	Technological Area Supported
Command/Destruct System	1959	$ 47	$ 282	Radio command of space and rocket vehicles
Research Telescope #2 (RT-2)	1960	197	451	Obtaining spectra of artificial meteors
Ballistic Camera Range	1960	720	NA	Trajectory determination of reentering bodies
NASA 670 and 671[a] (Range Surveillance Aircraft)	1960	4180	4180	Radar surveillance of rocket impact areas; calibration and exercise of tracking and data-acquisition systems; frequency interference detection
USNS *Range Recoverer*[b]	NA	350[c]	450[c]	Range surveillance radar, telemetry, and communications
Ionosphere Sounding Station	1961	50	70	Vertical incidence sounding to determine ionospheric characteristics
Meteorological Facility[d]	1962	260	300	Meteorological support of launchings

[a] Lockheed Super-Constellation aircraft, Navy-owned.

[b] MSTS-owned, contractor-operated (Litton Industries, Inc., Electronics Systems).

[c] Systems cost.

[d] U.S. Weather Bureau-operated.

NA = Data not available. For definition of terms in headings, see introduction to Chapter Two.

Source: NASA, *Technical Facilities Catalog* (March 1967 ed.), I, Sect. 9.

Table 6-142. Industrial Real Property
(as of June 30; money amounts in thousands)[a]

Fort Churchill, Manitoba, Canada	1967	1968
Land	0	0
Buildings		
Number	68	68
Area, thousands of sq m	8 402.5	8 402.5
(and sq ft)	(90 443)	(90 443)
Value		
Land	0	0
Buildings	$2558	$2557
Other structures and facilities	270	271
Total real property	$2828	$2828

[a] These figures are included in Table 6-143; data for earlier years are not available.

Source: NASA, Office of Facilities.

Table 6-143. Property
(as of June 30; money amounts in thousands)[a]

Category	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
Land in hectares (and acres)										
Owned	1248.7 (3085.6)[b]	2657.8 (6567.6)[c]	2657.8 (6567.6)	2656.8 (6565)	2655.1 (6561)	2655.1 (6561)	2655.1 (6561)	2655.1 (6561)	2676.5 (6613.7)[d]	2676.5 (6613.7)
Leased	NA	NA	NA	4.5 (11)	3.6 (9)	3.6 (9)	4.1 (10)	4.1 (10)	3.8 (9.6)	3.9 (9.8)
Buildings										
Number owned	NA	NA	NA	NA	258	278	270	356	358	385
Area owned, thousands of sq m (and sq ft)	NA	NA	NA	72.7 (783)	86.7 (933)	167.3 (1801)	93.5 (1006)	103.3 (1112)	103.8 (1117)	105.9 (1140)
Area leased	NA	NA	NA	0	0	0	0	0	0	0
Value										
Land	NA	NA	NA	NA	$ 592	$ 592	$ 592	$ 592	$ 611	$ 611
Buildings	NA	NA	NA	NA	13 397	20 602	22 517	22 241[f]	23 159	23 665
Other structures and facilities	NA	NA	NA	NA	17 037	21 784	27 640	32 822	35 360	39 516
Real property	NA	NA	NA	NA	$31 026	$42 978	$50 749	$55 655	$59 130	$63 927
Capitalized equipment	NA	NA	NA	$6000	$ 9 177	$12 965	$18 100	$26 908	$34 235	$35 241

[a] Including facilities at Fort Churchill, Manitoba, Canada. Data for FY 1959–FY 1961 were reported by Langley Research Center, without separate figures for Wallops Station. For definition of terms, see introduction to Chapter Two.

[b] Wallops Island only, and 1.1 hectares (2.6 acres) of mainland for boat dock area, which was sold in 1961 (FY 1962).

[c] Wallops Main Base (Chincoteague Naval Air Station), acquired July 1, 1959.

[d] Acquisition of Eastville (Va.) tracking site.

[e] Land for offsite camera tracking stations.

[f] Although number of buildings and total square feet increased during FY 1966, value of buildings dropped because of reclassification of some buildings as structures.

NA = Data not available.

Source: NASA, Office of Facilities.

Table 6-144. Value of Real Property Components as Percentage of Total
(as of June 30; total real property value in thousands)

Component	1963[a]	1964	1965	1966	1967	1968
Land	1.9	1.4	1.1	1.0	1.0	1.0
Buildings	43.2	47.9	44.4	40.0	39.2	37.0
Other structures and facilities	54.9	50.7	54.5	59.0	59.8	62.0
	100.0	100.0	100.0	100.0	100.0	100.0
Total Wallops real property value	$31 026	$42 978	$50 749	$55 655	$59 129	$63 927

[a] Data for earlier years are not available.

Source: Derived from Tables 2-10 through 2-13 in Chapter Two.

Table 6–145. Personnel

Employee Category[a]	1960		1961		1962		1963		1964		1965		1966		1967		1968
	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30	12/31	6/30
Requested for FY ending	250		300		299		440		518		518		518		518		518
Total, paid employees	229	297	302	371	421	430	493	502	530	523	554	526	563	538	576	509	565
Permanent	228	277	292	359	383	409	473	483	519	513	520	509	512	506	499	496	497
Temporary	1	20	10	12	38	21	20	19	11	10	34	17	51	32	77	13	68
Code group (permanent only)																	
200[b]	11	11	4	4	5	5	6	7	8	8	8	6	5	6	5	4	3
700[c]	17	34	42	45	52	53	64	68	73	74	76	79	80	75	77	77	83
900	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Subtotal	28	45	46	49	57	58	70	75	81	82	84	85	85	81	82	81	90
600[d]	0	7	9	14	16	21	24	24	27	26	28	26	32	36	40	42	39
500	50	43	46	61	65	61	76	76	86	80	79	81	80	80	81	79	79
300	17	35	31	43	44	51	75	65	71	63	161	175	175	185	176	188	186
100	133	147	160	192	201	218	228	243	254	262	168	142	140	124	120	106	103
Subtotal	200	232	246	310	326	351	403	408	438	431	436	424	427	425	417	415	407
Excepted: on duty	1	1	2	2	2	2	2	1	1	1	1	1	1	2	2	2	2
Accessions: permanent	8	51	16	62	25	34	80	51	68	30	42	22	29	27	21	NA	NA
Accessions: temporary	4	33	52	37	47	14	18	17	12	12	27	30	45	48	64	NA	NA
Military detailees	0	2	3	3	4	4	2	2	2	2	2	1	1	2	1	2	2

[a] Wallops Station began reporting as an independent installation in January 1960, with 225 employees transferred from Langley Research Center.

[b] Beginning June 30, 1961, the data reflect conversion of some professionals from the 200 Code group (engineers) to the 700 Code group (aerospace technologists). For key to Code group numbers and definition of terms, see Chapter Three.

[c] Data before June 30, 1961, are for "aeronautical research scientists." Beginning June 30, 1961, the data reflect conversion of these personnel members to the 700 Code group (aerospace technologists).

[d] Before Dec. 31, 1960, the data reflect inclusion of Code group 600 personnel in the 500 Code group.

NA = Data not available.

Source: NASA, Personnel Division. Data through Dec. 31, 1966, from NASA Quarterly Personnel Statistical Report; data after Dec. 31, 1966, from NASA Personnel Management Information System and the NASA Supplement to SF 113–A, "Monthly Report of Federal Civilian Employment Short Form."

Table 6-146. Distribution of Permanent Personnel Positions by Fiscal Year and Budget Activity[a]

Program	1959[b]	1960[b]	1961	1962	1963	1964	1965	1966	1967	1968
Manned space flight			36	0	0	0	0	0	0	0
(% of total)	(0.0)	(10.0)	(11.8)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Space applications			3	60	14	19	6	5	5	11
(% of total)	(2.0)	(5.0)	(1.0)	(14.7)	(3.1)	(3.7)	(1.2)	(0.9)	(0.9)	(2.2)
Unmanned investigations in space			153	145	48	60	74	81	81	67
(% of total)	(3.0)	(10.0)	(50.2)	(35.6)	(10.7)	(11.6)	(14.3)	(15.6)	(15.6)	(13.6)
Space research and technology			0	93	41	55	51	34	34	39
(% of total)	(10.0)	(20.0)	(0.0)	(22.9)	(9.2)	(10.7)	(9.8)	(6.6)	(6.6)	(7.9)
Aircraft technology[c]			113	0	13	17	15	20	20	8
(% of total)	(75.0)	(45.0)	(37.0)	(0.0)	(2.9)	(3.3)	(2.9)	(3.9)	(3.9)	(1.6)
Supporting activities[d]			0	109	331	365	372	378	378	369
(% of total)	(10.0)	(10.0)	(0.0)	(26.8)	(74.1)	(70.7)	(71.8)	(73.0)	(73.0)	(74.7)
Total			305	407	447	516	518	518	518	494

[a] Based on number of actual positions reported in annual NASA Budget Estimates. FY 1961 actual figure was reported in NASA, *Budget Estimates, FY 1963*; FY 1962 actual figure was reported, in NASA, *Budget Estimates, FY 1964*, etc.

[b] Actual positions data are not available for FY 1959 and FY 1960. Percentages in these two columns are based on distribution used by NASA Office of Programming, Budget Operations Division, in preparing *History of Budget Plans, Actual Obligations, and Actual Expenditures for Fiscal Years 1959 Through 1963* (Washington, D.C.: NASA 1965), Sect. 8.

[c] FY 1961 figure represents "aircraft and missile technology."

[d] FY 1963 and later figures include tracking and data acquisition, technology utilization, and general support positions. Until FY 1963 support positions were reported with the five other budget activities. FY 1962 figure represents only tracking and data acquisition.

Sources: NASA, *Budget Estimates*, FY 1963–FY 1969; NASA, Budget Operations Division.

Table 6-147. Funding by Fiscal Year
(program plan as of May 31, 1968, in millions)

Appropriation Title	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968	Total
Research and development	–	$1.00	$2.60	$ 0.60	$ 2.70	$ 4.30	$ 6.20	$ 7.50	$ 6.50	$ 7.20	$ 38.60
Construction of facilities[a]	$16.14	0	2.03	11.32	4.16	0.51	1.70	1.05	0.21	0.74	37.86
Administrative operations[b]	1.36	2.65	4.99	7.14	8.90	8.78	11.13	9.35	9.74	8.86	72.90
Total	$17.50	$3.65	$9.62	$19.06	$15.76	$13.59	$19.03	$17.90	$16.45	$16.80	$149.36

[a] Does not include facilities planning and design.

[b] FY 1959-1962 appropriations were for salaries and expenses; FY 1963 appropriation was for research, development, and operation.

Source: NASA, Office of Programming, Budget Operations Division, *History of Budget Plans, Actual Obligations, and Actual Expenditures for Fiscal Years 1959 Through 1963* (Washington, D.C.: NASA, February 1965); NASA, Budget Operations Division, "Status of Approved Programs," FY 1959-FY 1968, May 1968.

Table 6-148. Actual Obligations for Construction of Facilities by Fiscal Year and Program Year
(in millions)

Program Year	Program Plan[a]	FY 1959	FY 1960	FY 1961	FY 1962	FY 1963	FY 1964	FY 1965	FY 1966	FY 1967	FY 1968	Total
1959	$16.1	$6.4	$5.1	$2.3	$1.3	$0.4	$0.3	$0.1	*	*	0	$16.1
1960	0		0	0	0	0	0	0	0	0	0	0
1961	2.0			0.2	0.7	0.9	0.1	*	*	0	0	2.0
1962	11.4				5.1	3.6	0.7	1.7	$0.3	*	-*	11.4
1963	4.2					0.4	2.6	0.5	0.1	$0.3	*	4.1
1964	0.6						0.6	*	*	0	0	0.6
1965	1.8							0.8	0.1	0.2	$0.3	1.5
1966	1.1								*	*	1.0	1.1
1967	0.2									0.2	0	0.2
1968	0.7										0.2	0.2
Total	$38.1	$6.4	$5.1	$2.6	$7.1	$5.3	$4.2	$3.4	$0.6	$0.9	$1.6	$37.2[b]

[a] As of June 30, 1968; includes facilities planning and design.

[b] Includes $16.1 million for tracking and data-acquisition facilities.

* = Less than $100 000. Because of rounding, columns and rows may not add to totals.

Source: NASA, Budget Operations Division, "Status of Approved Programs, Construction of Facilities," FY 1959-FY 1968, June 1968; NASA, Financial Management Division, "Summary Financial Status of Programs," June 30, 1968.

Table 6-149. Total Procurement Activity by Fiscal Year
(money amounts in millions)

	1961	1962	1963	1964	1965	1966	1967	1968	Total
Net value of contract awards	$1.5	$11.0	$11.9	$13.0	$15.4	$12.1	$12.7	$12.5	$90.1
Percentage of NASA total	0.2%	1.0%	0.4%	0.3%	0.3%	0.2%	0.3%	0.3%	0.3%

Source: NASA, Procurement and Supply Division, *NASA Procurement: October 1, 1958 to June 30, 1960* (Washington, D.C.: NASA, September 1960); NASA, *Annual Procurement Report*, Fiscal Years 1961–1968 (Washington, D.C.: NASA, 1962–1968).

FORMER FIELD ACTIVITIES

FORMER FIELD ACTIVITIES

NASA LIAISON OFFICE

Location: Wright-Patterson Air Force Base, Dayton, Ohio.

History

The NACA-established office was closed on April 1, 1959, six months after the creation of NASA.[1]

NASA OFFICE-DOWNEY (NASA-O-Downey)

Location: Downey, Los Angeles County, California.

Director: John R. Biggs (May 13, 1962-May 5, 1967).

History

NASA established a contract management unit at North American Aviation, Inc., Space and Information Systems Division plant in Downey, California, May 11, 1962, as a component of the Western Operations Office (WOO). The decision to establish a NASA organization at Downey was a departure from the policy of using Department of Defense capability. NASA-O was formed to represent NASA in dealing with the company on plant-wide matters and to provide day-to-day contract management support for the Apollo command and service module and Saturn V second-stage contracts. Technical management of the contracts was provided by the

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[1] NASA Release, Feb. 9, 1959.

Fédération Aéronautique Internationale Gold Space Medal

Established in 1962, the FAI Gold Space medal is awarded to astronauts "who, alone or in groups, realize an outstanding performance in space."

1962	Andrian G. Nikolayev
	Pavel R. Popovich
1963	Valentina Nikolayeva-Tereshkova
1964	Vladimir Komarov
	Boris B. Yegorov
	Konstantin P. Feoktistov
1965	Aleksey Leonov
1966	Capt. James A. Lovell, Jr. (USN)
1967	No award given
1968	Col. Frank Borman (USAF)
	Capt. James A. Lovell, Jr. (USN)
	Lt. Col. William A. Anders (USAF)

N. Flight Safety Foundation

Laura Taber Barbour Award

The Laura Taber Barbour Award was established in 1956 and is given annually "for notable achievement which shall tend to advance safety in aeronautics and which contributes toward a method of avoiding . . . suffering or loss of life in air travel."

1958	James Martin
1959	Alan L. Morse
1960	Melvin N. Gough
1961	E. S. Calvert
	J. W. Sparke
1962	Otto E. Kirchner, Sr.
1963	David D. Thomas
1964	Philip Donely
	Jerome Lederer
1965	Arthur E. Jenks
1966	Francis P. McCourt
1967	W. M. Kauffman
	W. F. Milliken
	W. U. Breuhauf
1968	Walter Pye

Richard Hansford Burroughs International Test Pilot Award

Established in 1963, this award is given to "recognize contributions by a test pilot or group of test pilots to safe and efficient flight testing in the realm of atmospheric or space flight."

1963	Joseph J. Tymczyszyn
1964	Brian Trubshaw
1965	Fred J. Drinkwater III
1966	William M. Magruder
1967	John P. Reeder
1968	Alvin S. White

C-7

O. International Academy of Astronautics of the International Astronautical Federation

David and Florence Guggenheim International Astronautics Award

This award, established in 1961, is given annually "to an individual who has made outstanding contributions to the progress of astronautics during the preceding five years." The honorarium is $1000.

1961	Sir Bernard Lovell	1965	Mstislav V. Keldysh
1962	James A. Van Allen	1966	Robert R. Gilruth
1963	Marcel Nicolet	1967	Jacques-Emile Blamont
1964	Wallace Osgood Fenn	1968	Zdenek Svestka

P. International Astronautical Federation

Andrew G. Haley Award

Established in 1961, this award is given in recognition to the development of space law and international cooperation in the peaceful uses of space. It is named for Andrew G. Haley (1905-1966), an early advocate of outer space rule of law. The honorarium is $500.

1961	John Cobb Cooper	1964	Eugene Korovine
	Vladimir Kopal		Cyril Horsford
	Michael Smirnoff		Aldo Armando Cocca
1962	Alex Meyer	1965	Aldo Armando Cocca
	Manfred Lachs		Myres McDougal
	Antonio Ambrosini	1966	Manfred Lachs
1963	Eugene Pépin	1967	No award given
	Ernst Fasan	1968	Eilene Galloway

Q. National Aeronautic Association

Formed in 1922, the NAA is the U.S. representative to the Fédération Aéronautique Internationale.

Frank G. Brewer Trophy

Established in 1943, the Frank G. Brewer Trophy is awarded annually for the greatest achievement in the field of air youth education and training, "accomplished by any individual, group of individuals, or organization."

1958	Evan Evans
1959	Paul E. Garber
1960	George N. Gardner
1961	James V. Bernardo
1962	Merlyn McLaughlin
1963	Marrilyn Link
1964	Gill Robb Wilson
1965	Jane N. Marshall
1966	Mervin K. Strickler, Jr.
1967	Roland H. Spaulding
1968	Joseph T. Geuting, Jr.

Robert J. Collier Trophy

This award was established in 1911 as the "Aero Club of America Trophy." In 1922, the Aero Club of America was incorporated into the National Aeronautic Association, and NAA renamed the award the Robert J. Collier Trophy in 1944 honoring its donor. The trophy is presented annually "for the greatest achievement in aeronautics or astronautics in America, with respect to improving the performance, efficiency or safety of air or space vehicles, the value of which has been thoroughly demonstrated by actual use during the preceding year." This award is usually presented by the President of the United States.

1958	U.S. Air Force and Industry Team responsible for the F-104 Interceptor
	Maj. Clarence L. Johnson (USAF)
	Neil Burgess
	Gerhard Neumann
	Maj. Howard C. Johnson (USAF)
	Capt. Walter W. Irwin (USAF)
1959	U.S. Air Force, Corvair, and Space Technology Laboratories
1960	Vice Adm. William Rayborn (USN)
1961	Maj. Robert M. White (USAF)
	Joseph A. Walker
	A. Scott Crossfield
	Cdr. Forrest S. Petersen (USN)
1962	Maj. L. Gordon Cooper, Jr. (USAF)
	Lt. Col. John H. Glenn, Jr. (USMC)
	Maj. Virgil I. Grissom (USAF)
	Lt. Cdr. Walter M. Schirra, Jr. (USN)
	Cdr. Alan B. Shepard, Jr. (USN)
	Maj. Donald K. Slayton (USAF)
	Lt. Cdr. M. Scott Carpenter (USN)
1963	Maj. Clarence L. Johnson (USAF)
1964	Gen. Curtis E. LeMay (USAF)
1965	James E. Webb
	Hugh L. Dryden
1966	James S. McDonnell, Jr.
1967	Lawrence A. Hyland
1968	Col. Frank Borman (USAF)
	Capt. James A. Lovell, Jr. (USN)
	Lt. Col. William A. Anders (USAF)

Wright Brothers Memorial Trophy

The Wright Brothers Memorial Trophy, established in 1948, is awarded each year to a living individual for "significant public service as a civilian of enduring value to aviation in the United States."

1958	John Francis Victory
1959	William P. MacCracken, Jr.
1960	Frederick C. Crawford
1961	A. S. "Mike" Monroney
1962	John Stack
1963	Donald W. Douglas, Sr.
1964	Harry F. Guggenheim
1965	Jerome Lederer
1966	Juan T. Trippe
1967	Igor I. Sikorsky
1968	Warren G. Magnuson

R. National Geographic Society

Hubbard Medal

This medal is conferred by the National Geographic Society's Board of Trustees for outstanding discovery and exploration. It is named in honor of one of the founders of the Society and its first president, Gardiner Greene Hubbard.

1958	Paul A. Siple
1959	Sir Vivian Fuchs U.S. Navy Antarctic Expeditions
1962	Dr. and Mrs. Louis S. B. Leakey John H. Glenn, Jr.
1963	American Mount Everest Expedition
1967	Juan Trippe
1968	Col. Frank Borman (USAF) Capt. James A. Lovell, Jr. (USN) Lt. Col. William A. Anders (USAF)

S. National Space Club

Founded as the National Rocket Club in 1957, the name was changed to the National Space Club in late 1963.

Astronautics Engineer Achievement Award

Established in 1959, the Astronautics Engineer Achievement Award is "given annually to an accredited engineer who has made an outstanding contribution to the advancement of space technology, an award based on personal accomplishment."

1959	Rudolf F. Hoelker
1960	Richard C. Canright
1961	William J. O'Sullivan, Jr.
1962	William G. Stroud
1963	Jack N. James
1964	Harold A. Rosen
	Donald D. Williams
1965	Harris M. Schurmeier
1966	Charles W. Mathews
1967	Robert J. Helberg
1968	Howard H. Haglund

Robert H. Goddard Historical Essay Award

Established in 1962, this award is made annually to the winner of a national competition in historic essays on rocketry and astronautics. The honorarium is $500.

1962	No award given
1963	R. Cargill Hall
1964	R. Cargill Hall
1965	John M. Tascher
1966	Airman 2/C Frank H. Winter (USAF)
1967	Ensign Richard A. Hobbs (USN)
1968	No award given

Robert H. Goddard Memorial Lecture

Established in 1966 by the National Space Club, this award stresses the importance of contributions made by Robert H. Goddard (1882-1945) to the development of the space program. Selection of the lecturer is made by a panel from men of high stature who have made outstanding contributions to the aerospace field. The honorarium is $1000.

1966	Robert C. Seamans, Jr.
1967	Joseph F. Shea
1968	Gen. Bernard A. Schriever (USAF, Ret.)

Robert H. Goddard Memorial Trophy

Established in 1958, this award is given annually for outstanding achievement to advance space flight programs contributing to U.S. leadership in astronautics.

1958	Wernher von Braun
1959	S. K. Hoffman
1960	Karel J. Bossart
1961	Lockheed Missiles & Space Co.
1962	Robert R. Gilruth
1963	Lt. Col. John H. Glenn, Jr. (USMC)
1964	Hugh L. Dryden
1965	William H. Pickering
1966	Lyndon B. Johnson
1967	George P. Miller
1968	Robert C. Seamans, Jr.

Nelson P. Jackson Aerospace Award

Established in 1960 in honor of a founder of the National Rocket Club, the Nelson P. Jackson Aerospace Award, now administered by the National Space Club, is awarded annually to a recipient in the aerospace industry "for an outstanding contribution of the missile, aircraft, and space field."

1961	U.S. Air Force and the Discoverer satellite industrial team: Bell Aerosystems Co., Douglas Aircraft Co., General Electric Co., Lockheed Aircraft Corp., and Rocketdyne Div. of North American Aviation, Inc.
1962	Astro-Electronics Div., Radio Corp. of America
1963	American Telephone & Telegraph Co.
1964	General Dynamics Astronautics Div. and McDonnell Aircraft Corp.
1965	Florida Research and Development Center, Pratt & Whitney Aircraft Div. of United Aircraft Corp.
1966	NASA-Air Force-Industry Team
1967	Boeing Co.
1968	Hughes Aircraft Co.

National Space Club Press Award

Established in 1960 as the National Rocket Club Award and later renamed the National Space Club Press Award, the honor is presented annually "in recognition of contributions which added to public understanding and appreciation of astronautics."

1961	Edward R. Murrow
1962	The *New York Times*
1963	Radio-Television Industry
1964	Editors and Staff of *Fortune* Magazine
1965	*Aviation Week & Space Technology* Magazine
1966	William P. Taub
1967	William J. Coughlin
1968	Edward C. Welsh

T. Society of Automotive Engineers, Inc.

Arch T. Colwell Merit Award

Established in 1965 by the Society of Automotive Engineers, Inc., the Arch T. Colwell Merit Award is given in recognition of outstanding technical papers in the field of automotive engineering. There is no restriction in this award as to the number of authors who may be honored.

1965 A. E. W. Austen
T. Priede
Kenneth C. Bachman
R. Thomas Bundorf
Walter Cornelius
L. William Huellmantel
Harry R. Mitchell
Paul H. Denke
Clayton W. Bentley
Robert T. Hunt
Walter B. Horne, LaRC
Upshur T. Joyner, LaRC
William LeFevre
K. J. McAulay
Tang Wu
Simon K. Chen
G. L. Borman
P. S. Myers
O. A. Uyehara
A. L. McPike
W. A. Turunen
J. S. Collman
1966 L. B. Graiff
Marvin W. Jackson
A. C. Knoell, JPL
S. O. Kronogard
Paul E. Kueser
Robert T. Larsen
W. M. Magruder
J. F. McDonald
W. J. Mayer
C. P. Moore
D. P. Krause
W. H. Lange
C. B. Murphy
J. J. Klepaczyk
Noel Penny
R. C. Puydak
R. S. Auda
Charles E. Scheffler
A. R. Spencer
W. M. Spurgeon
J. L. Wingle
1967 W. L. Brown
Fujio Nagao
Yuzuru Shimamoto
Bruce D. Van Deusen
Gerald E. McCarron
Ralph S. Mosher
H. K. Newhall
E. S. Starkman
W. A. Daniel
J. S. Alford
Philip Bono
Frank E. Senator
D'Amaso S. Garcia
Jay A. Bolt
David L. Harrington
M. L. Caplan
W. W. Thayer
J. D. Reams
R. G. Ahlvin
D. N. Brown
J. L. Bicknell
Walter Cornelius
Donald L. Stivender
Robert E. Sullivan
1968 I. N. Bishop
A. Simko
Jon D. Parisen
William A. McGowan
P. E. Rubbert
Gary R. Saaris
Donald E. Muehlberger
L. J. Nestor
L. Maggitti
Donald L. Stivender
Bo Björkman
Michael C. Kaye
Jerry P. Barrack
Jerry V. Kirk
John K. Jackson
Mario S. Bonura
David F. Putnam

Charles Matthews Manly Memorial Award

This award, established in 1928, is made "to the author of the best paper relating to theory or practice in the design or construction of, or research on, aerospace engines, their parts, components, or accessories." The honorarium is $150.

1958	Robert H. Boden
1959	No award given
1960	Donald B. Mackay
1961	John M. Tyler
	Thomas G. Sofrin
1962	D. B. Colyer
	J. W. Bjerklie
1963	Joab J. Blech
	Antoni Paluszny
1964	No award given
1965	William A. Reinhart
	Elling Tjonneland
1966	No award given
1967	Mark R. Kulina
	John F. Mullen
	Magge S. Natesh
	Herbert W. Saltzman
1968	Brian Brimelow
	H. Ivan Bush
	G. K. Richey
	Donald J. Stava

Wright Brothers Medal

Established in 1924, the Wright Brothers Medal is awarded annually "to the author of the best paper on aerodynamics or structural theory, or research, or construction or operation of airplanes or spacecraft presented at a meeting of the Society or any of its Sections during the calendar year." The honorarium is $150.

1958	Kermit E. Van Every
1959	Milford Guy Childers
1960	Ferdinand Basil Greatrex
1961	Carleton M. Mears
	Robert L. Peterson
1962	Robert P. Rhodes, Jr.
	D. E. Chriss
	Philip M. Rubins
1963	Sitaram Pao Valluri
	James Brinton Glassco
	George Eugene Bockrath
1964	Marion O. McKinney, Jr.
	Richard E. Kuhn
	John P. Reeder, LaRC
1965	W. W. Williams
	Capt. G. K. Williams (USA, Ret.)
	W. C. J. Garrard
1966	Julian Wolkovitch
1967	John A. McKillop
1968	Leonard J. Nestor
	Lawrence Maggitti, Jr.

U. Society of Experimental Test Pilots

Iven C. Kincheloe Memorial Award

The Iven C. Kincheloe Memorial Award, established in 1958, is given "for outstanding professional accomplishment in the conduct of flight testing."

1958	James R. Gannett Joseph J. Tymcyzszyn
1959	Maj. Robert G. Ferry (USAF)
1960	A. Scott Crossfield William M. Magruder
1961	Joseph A. Walker Maj. Robert M. White (USAF)
1962	Donald M. McCracken
1963	Lt. Cdr. M. Scott Carpenter (USN) Lt. Col. John H. Glenn, Jr. (USMC) Maj. L. Gordon Cooper, Jr. (USAF) Capt. Walter M. Schirra, Jr. (USN) Maj. Virgil I. Grissom (USAF) Cdr. Alan B. Shepard, Jr. (USN) Maj. Donald K. Slayton (USAF)
1964	Pilots of the YF-12A Louis W. Schalk William C. Park Robert J. Gilliland James D. Eastham
1965	Alvin S. White
1966	Milton O. Thompson
1967	Richard L. Johnson
1968	Drury W. Wood, Jr.

V. United Engineering Trustees

Daniel Guggenheim Medal

Established in 1928 in cooperation with the Institute of Aeronautical Sciences, the Society of Automotive Engineers, and the American Society of Engineers, this medal is given "for notable achievement in the advancement of aeronautics."

1958	William Littlewood
1959	Sir George R. Edwards
1960	Grover Loening
1961	Jerome Lederer
1962	James H. Kindelberger (posthumously)
1963	James S. McDonnell, Jr.
1964	Robert H. Goddard (posthumously)
1965	Sir Sydney Camm (posthumously)
1966	Charles Stark Draper
1967	George S. Schairer
1968	H. M. Horner

3. Government Awards

A. Atomic Energy Commission

Enrico Fermi Award

Established in 1956, this award honors Enrico Fermi for his contributions to basic neutron physics and the achievement of the controlled nuclear reaction. It is presented "not more often than annually" for "outstanding scientific or technical achievements or for scientific management and engineering in the development of atomic energy." The honorarium is $25 000, or $50 000 divided equally if a joint award.

1958	Eugene P. Wigner
1959	Glenn T. Seaborg
1961	Hans A. Bethe
1962	Edward Teller
1963	J. Robert Oppenheimer
1964	Vice Adm. Hyman G. Rickover (USN)
1966	Lise Meitner Otto Hahn Fritz Strassman
1967	No award given
1968	John A. Wheeler

E. O. Lawrence Memorial Award

Established in 1959 to honor Ernest O. Lawrence, inventor of the cyclotron, this award is made annually to not more than five U.S. citizens under 45 years of age who have made "recent, especially meritorious contributions to the development, use or control of atomic energy in areas of all sciences related to atomic energy, including medicine and engineering." The honorarium is not less than $5000 each and not more than a total of $25 000.

1960	Harvey Brooks John S. Foster, Jr. Isadore Perlman Norman F. Ramsey, Jr. Alvin M. Weinberg
1961	Leo Brewer Henry Hurwitz, Jr. Conrad L. Longmire Wolfgang K. H. Panofsky Kenneth E. Wilzbach
1962	Andrew A. Benson Richard P. Feynman Herbert Goldstein Anthony L. Turkevich Herbert F. York
1963	Herbert J. C. Kouts L. James Rainwater Lewis Rosen James M. Taub Cornelius A. Tobias
1964	Jacob Bigeleisen Albert L. Latter Harvey M. Patt Marshall N. Rosenbluth Theos J. Thompson
1965	George A. Cowan Floyd L. Culler Milton C. Edlung Theodore B. Taylor Arthur C. Upton
1966	Harold M. Agnew Ernest C. Anderson Murray Gell-Mann John R. Huizenga Paul R. Vanstrum
1967	Mortimer M. Elkind John M. Googin Allan F. Henry John O. Rasmussen Robert N. Thorn
1968	James R. Arnold E. Richard Cohen Val L. Fitch Richard Latter John B. Storer

B. National Academy of Engineering (Chartered)

Founders' Medal

Established in 1965 by the 25 original members of the National Academy of Engineering, The Founders' Medal is awarded annually for "outstanding contributions by an engineer both to his profession and to society."

1966	Vannevar Bush	1968	Vladimir K. Zworykin
1967	James Smith McDonnell		

C. National Academy of Sciences (Chartered)

John J. Carty Medal

Established in 1930 by the American Telephone & Telegraph Company, in honor of John J. Carty, a distinguished scientist and engineer, this award is presented not oftener than once every two years and is given to "an individual for noteworthy and distinguished accomplishment in any field of science."

1961	Charles H. Townes	1965	Alfred H. Sturtevant
1963	Maurice Ewing	1968	Murray Gell-Mann

Henry Draper Medal

Established in 1883 by Mrs. Henry Draper in memory of her husband, a former member of the Academy, the Henry Draper Medal is awarded not more than once every two years and is given for "investigations in astronomical physics."

1960	Martin Schwarzchild	1966	No award given
1962	Richard Tousey	1968	Bengt Edlen
1964	Martin Ryle		

J. Lawrence Smith Medal

Established in 1884, by Mrs. J. Lawrence Smith in memory of her husband, a former member of the Academy, this medal is presented not more than once every two years, and is awarded for "investigations of meteoric bodies."

1960	Ernst J. Ôpik	1967	John H. Reynolds
1962	Harold C. Urey		

James Craig Watson Medal

The James Craig Watson Medal was established in 1874 as a bequest of James Craig Watson, a former member of the Academy, to provide recognition of outstanding astronomical research.

1960	Yusuke Hagihara	1965	Paul Herget
1961	Otto Heckmann	1966	Wallace J. Eckert (19th recipient)
1962	No award given	1967	No award given
1963	No award given	1968	No award given
1964	Willem J. Luyten		

D. Smithsonian Astrophysical Observatory

Thomas Hodgkins Prize

The Hodgkins gold medal, named for philanthropist Thomas G. Hodgkins (1803-1892), was first awarded in 1899 to James Dewar and for the second time in 1902 to J.J. Thomson. This award is made for contributions to atmospheric research and carries a $3000 honorarium for each recipient.

1965	Joseph Kaplan Marcel Nicolet	Sydney Chapman (3rd, 4th, and 5th recipient)

E. Smithsonian Institution

Langley Medal

Established in 1908 by the Regents of the Smithsonian Institution, the Langley Medal was initiated by Alexander Graham Bell for the purpose of presenting an American award to the Wright Brothers. The Medal honors Samuel Pierpont Langley (1834-1906), aviation pioneer and founder of Smithsonian Astrophysical Observatory who served as the Smithsonian Institution's third Secretary from 1887 to 1906. Presented only occasionally, the medal is awarded by motion of the Secretary of the Smithsonian and a designated committee "for specially meritorious achievements in connection with the sciences of aeronautics and astronautics."

1960	Robert H. Goddard (posthumously)	1964	Cdr. Alan B. Shepard, Jr. (USN)
1962	Hugh L. Dryden	1967	Wernher von Braun (12th recipient)

F. United States Air Force

The Mackay Trophy (USAF)

The Mackay Trophy is awarded "to the Air Force person or persons who made the most meritorious flight of the year." The trophy was established in 1910 by Clarence H. Mackay and was first awarded in 1912 to Lt. Henry H. "Hap" Arnold. Deeded to the National Aeronautic Association after Mackay's death, the trophy is administered by the U.S. Air Force.

1958	TAC's Composite Air Strike Force
1959	USAF Thunderbird Aerial Team
1960	USAF 6593rd Test Squadron (Special)
1961	Maj. William R. Payne (USAF) Capt. William L. Polheumus (USAF) Capt. Raymond R. Wagner (USAF) (all of 43rd Bomb Wing)
1962	Maj. Robert G. Sowers (USAF) Capt. Robert McDonald (USAF) Capt. John T. Walton (USAF)
1963	Crew of C-47
1964	464th Troop Carrier Wing
1965	YF-12A/SR71 Task Force
1966	Lt. Col. Albert R. Horwarth (USAF)
1967	Maj. John H. Casteel (USAF) Capt. Richard L. Trail (USAF) Dean L. Hoar M/Sgt. Nathan C. Campbell (USAF)
1968	Lt. Col. Daryl D. Cole (USAF)

General Thomas D. White Space Trophy

Established in 1961 by Dr. Thomas W. McKnew, chairman of the National Geographic's Board of Trustees, the General Thomas D. White Space Trophy is presented annually to an Air Force member, Civil Service employee, or organization that made the foremost contribution to U.S. progress in aerospace. The trophy honors the late retired Air Force Chief of Staff.

1961	Capt. Virgil I. Grissom (USAF)
1962	Maj. Robert M. White (USAF)
1963	Maj. L. Gordon Cooper, Jr. (USAF)
1964	Air Force Systems Command
1965	Lt. Col. Edward H. White II (USAF)
1966	Alexander H. Flax
1967	John Paul McConnell
1968	Col. Frank Borman (USAF) Capt. James A. Lovell, Jr. (USN) Lt. Col. William A. Anders (USAF)

4. Miscellaneous Awards

A. Galabert International Prize for Astronautics

Established in 1957 by Mr. and Mrs. Henri Galabert, this award is presented annually for notable contributions "to human progress for the advancement of all sciences and techniques associated with astronautics." The award of $4000 is divided among several recipients.

1961	Ernst Stuhlinger Hermann Oberth
1962	Alle Massevitch Ary Sternfeld Yuri Gagarin Lt. Col. John H. Glenn, Jr. (USMC)
1963	No award given
1964	William H. Pickering Valentina Tereshkova
1965	Wernher von Braun Jean-Pierre Causse Roger Chevalier
1966	No award given
1967	No award given

B. Clifford B. Harmon Trust

Harmon International Trophies

Established in 1926, these aeronaut, aviator, and aviatrix trophies are awarded for "outstanding achievements in the arts and/or sciences of aeronautics."

Aeronaut	
1961	No award given
1962	Cdr. Malcolm D. Ross (USNR) Lt. Cdr. Victor A. Prather (USN) (posthumously)
1963	Nini Boesman
1964	No award given
1966	No award given
1967	No award given
1968	No award given

Aviator	
1961	A. Scott Crossfield Joseph A. Walker Maj. Robert M. White (USAF)
1962	Lt. Col. William R. Payne (USAF)
1963	Maj. Fitzhugh L. Fulton, Jr. (USAF)
1964	Maj. L. Gordon Cooper (USAF)
1966	Capt. James A. Lovell, Jr. (USN) Col. Frank Borman (USAF) Capt. Walter M. Schirra, Jr. (USN) Lt. Col. Thomas P. Stafford (USAF)
1967	Capt. James A. Lovell, Jr. (USN) Lt. Col. Edwin E. Aldrin, Jr. (USAF) Alvin S. White
1968	Maj. William J. Knight (USAF)

Aviatrix	
1961	No award given
1962	Jacqueline Cochran
1963	No award given
1964	Betty Miller
1966	No award given
1967	Sheila Scott
1968	No award given

C. University of California Institute of Navigation

Hays Award

Established in 1965, the Hays Award is given in memory of Norman P. Hays, an outstanding navigator, "to recognize individuals providing encouragement, inspiration, and support contributing to the advancement of navigation."

1965	Patrick R. J. Reynolds
1966	Alexander B. Winick
1967	Robert Clifton Duncan
1968	Gene R. Marner

Thomas L. Thurlow Navigation Award

Established in 1945 in honor of Colonel Thurlow to stimulate the development of the science of navigation in the United States. It is awarded "for the outstanding contribution to the science of navigation in the year."

1958	Charles F. Blair, Jr.
1959	William J. Tull
1960	Victor E. Carbonara
1961	John R. Moore
1962	Thomas E. Curtis
1963	Joseph A. Cestone
1964	Col. Robert A. Duffy (USAF)
1965	Ernst Ludwig Kramar
1966	W. J. O'Brien
1967	Winslow Palmer
1968	Maurice A. Meyer

APPENDIX B

MAJOR ORGANIZATION CHARTS

APPENDIX B

MAJOR ORGANIZATION CHARTS

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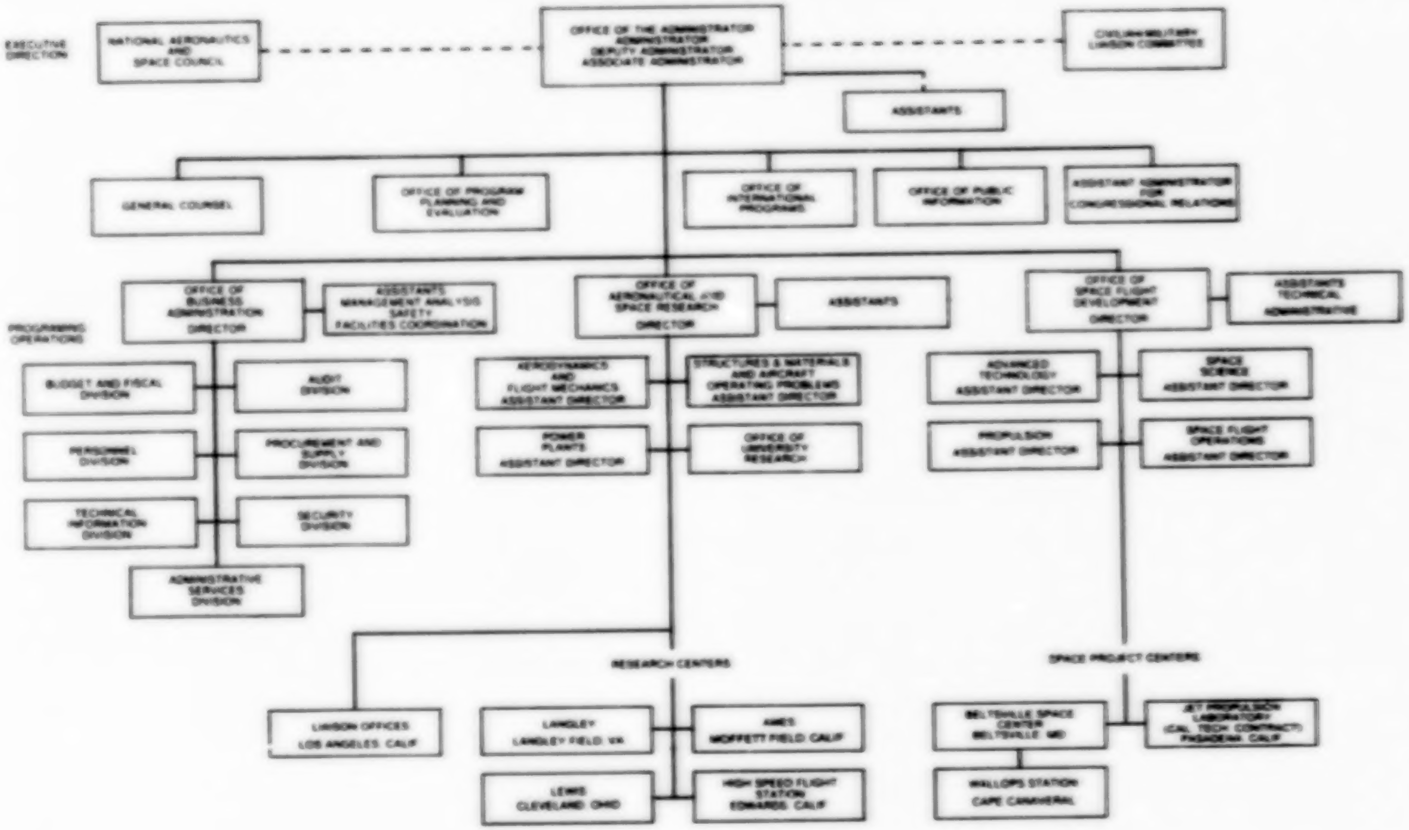
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NATIONAL AERONAUTICS AND SPACE COUNCIL
OFFICE OF THE ADMINISTRATOR ADMINISTRATOR DEPUTY ADMINISTRATOR ASSOCIATE ADMINISTRATOR
CIVILIAN-MILITARY LIAISON COMMITTEE
ASSISTANTS
GENERAL COUNSEL
OFFICE OF PROGRAM PLANNING AND EVALUATION
OFFICE OF INTERNATIONAL PROGRAMS
OFFICE OF PUBLIC INFORMATION
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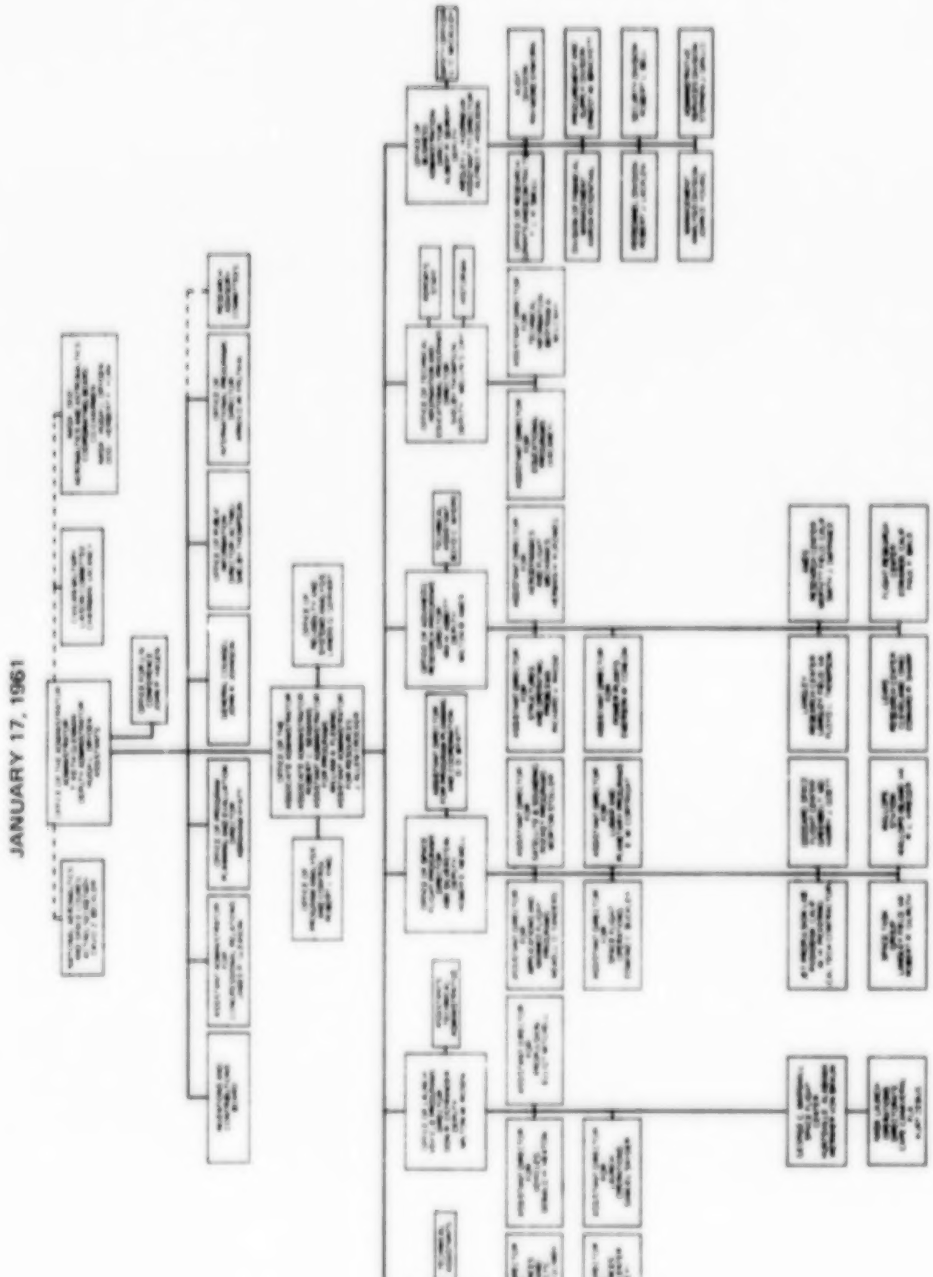
PROPULSION ASSISTANT DIRECTOR
SPACE FLIGHT OPERATIONS ASSISTANT DIRECTOR
RESEARCH CENTERS
LIAISON OFFICES LOS ANGELES, CALIF
LANGLEY LANGLEY FIELD, VA
AMES MOFFETT FIELD, CALIF
LEWIS CLEVELAND, OHIO
HIGH SPEED FLIGHT STATION EDWARDS, CALIF
SPACE PROJECT CENTERS
BELTSVILLE SPACE CENTER BELTSVILLE, MD
JET PROPULSION LABORATORY (CAL TECH CONTRACT) PASADENA, CALIF
WALLOPS STATION CAPE CANAVERAL



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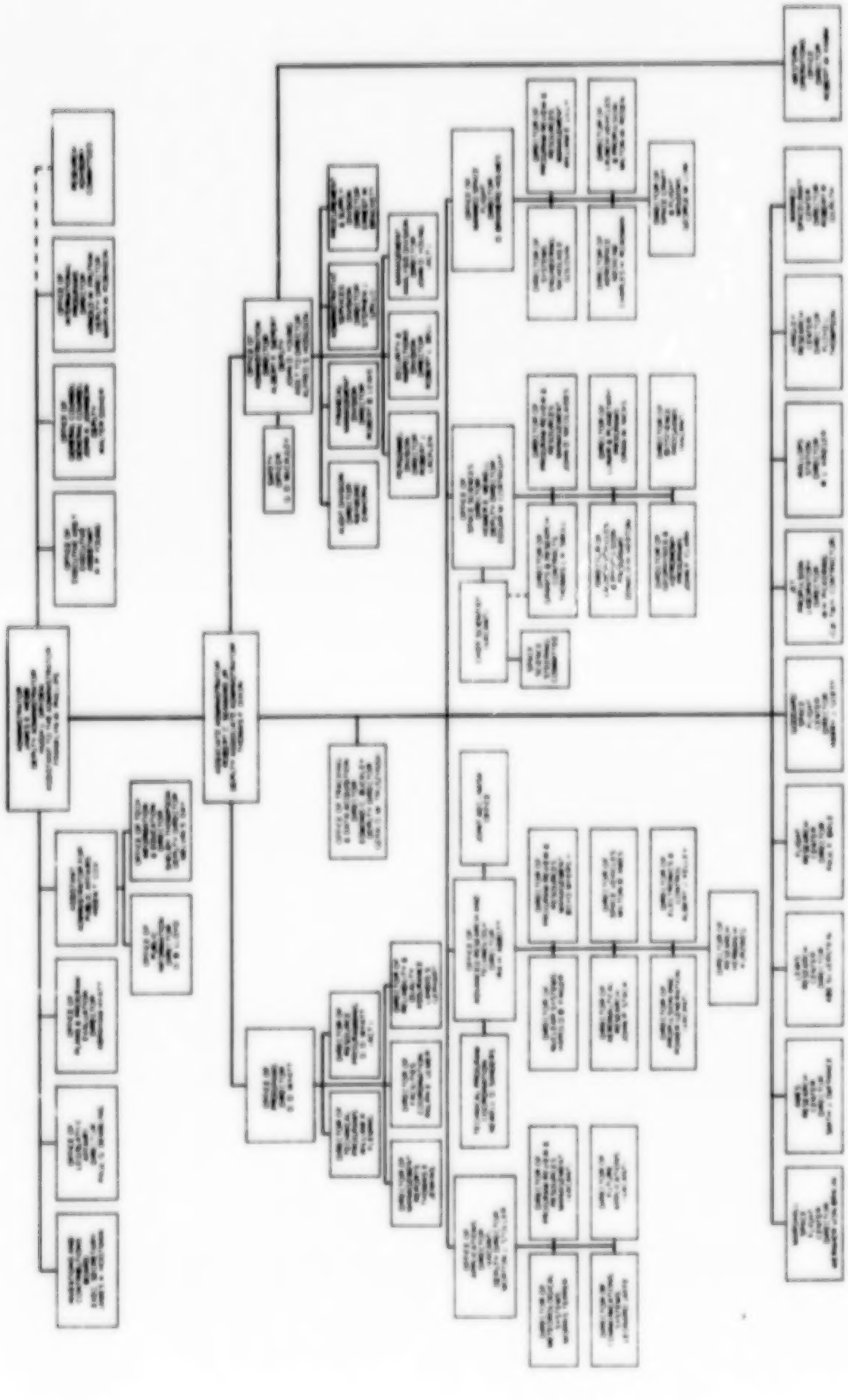
NOVEMBER 1, 1961



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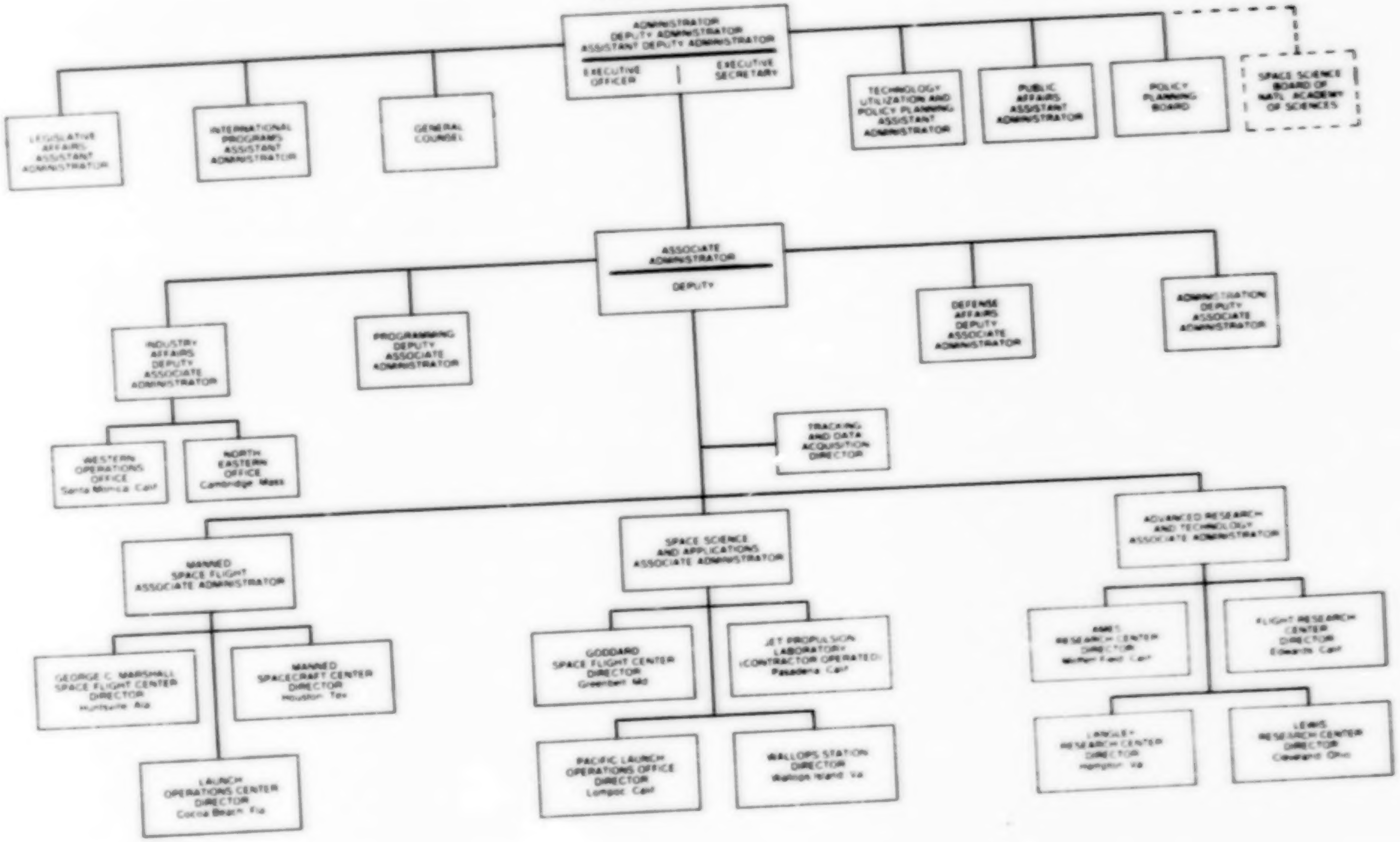
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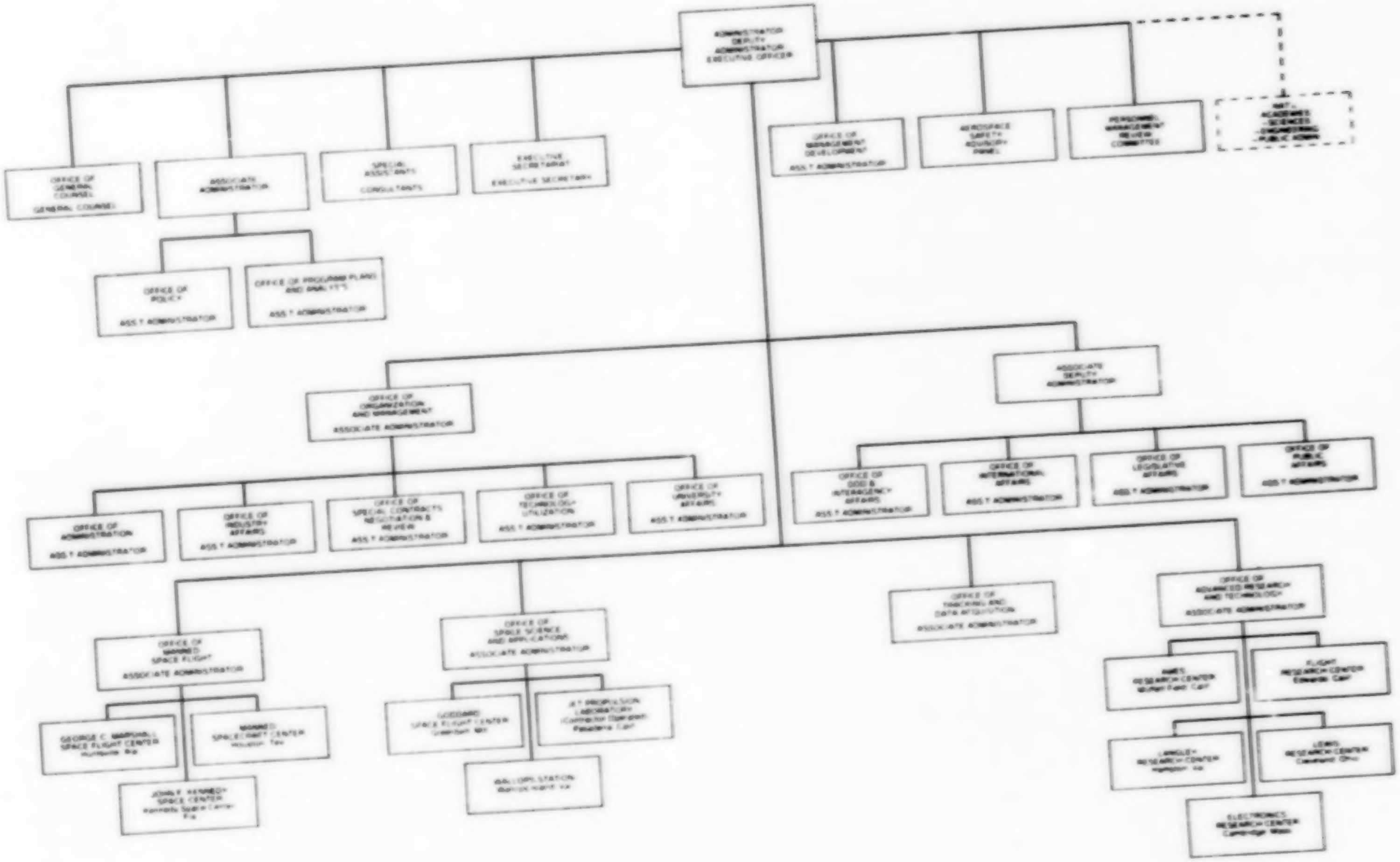
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